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AMERICAN JOURNAL

OF THE MEDICAL SCIENCES

AUGUST, 1928

ORIGINAL ARTICLES.

DRUNKENNESS.

A Quantitative Study of Acute Alcoholic Intoxication.*†

By Emil Bogen, M.D.,

CINCINNATI, OHIO.

"Wine is a Mocker. Strong Drink is Raging."

Alcoholism and Antiquity. Drunkenness is not a new phenomenon. The inebriety of Noah was only one of a large number of similar instances in the Bible and other ancient sources, and alcoholism has been a common feature of the life and literature of the Western World ever since. In every epoch and among every people have been seen examples of the ancient Proverb, "Who hath woe? Who hath sorrow? Who hath contentions? Who hath babbling? Who hath wounds without cause? Who hath redness of eyes?" "They that tarry long at the wine."

Popular attitudes to this condition have ranged from the rigid prohibition enjoined upon the "Faithful" Moslems by Mohammed to the ecstatic apotheosis of alcoholic intoxication by the inspired sensualist, Omar Khayyam. The Father of Medicine himself advised the drinking of wine in moderation, although he strongly condemned the delirium that comes from too much drink. Among the Greeks and Romans intoxication was regarded as a weakness, and the Spartan youths were shown drunken Helots as horrible

* This essay was awarded the Alvarenga Prize for 1927 by the College of Physicians of Philadelphia.

† Some of the material on which this essay is based has been published in the J. Am. Med. Assn., 1927, **89**, 1508; California and Western Med., 1927, **26**, 778; and J. of Med. of Cincinnati, September, 1927, **8**, 343, and Thesis for the degree of Master of Science, University of Cincinnati, 1927.

examples to be avoided, although total abstinence was seldom advised. Until recent times, in fact, it has been the state of drunkenness, and not the act of drinking, that has been condemned as reprehensible.

Alcoholism and the Law. The higher courts of Ohio, in the case of Gard *versus* State, 33 Ohio Circuit Courts, 632, have held that a man cannot be considered intoxicated within the meaning of the law of this state, even though the odor of alcohol on the breath, a flushed face and a disposition to talk loudly and freely be shown, unless it is further shown that he had "lost either the control of the faculties . . . or of the muscles of locomotion." In the following study a very strict construction has been set upon this ruling, and no person has been diagnosed as suffering from acute alcoholism in the absence of clear and convincing evidence of loss of control and coördination of the muscles of speech and of locomotion, in addition to mental alterations and the odor and symptoms of alcoholic imbibition.

TABLE I.—FIVE HUNDRED EXAMINATIONS FOR DRUNKENNESS CLASSIFIED BY ALCOHOLIC CONTENTS OF URINE.

	Mg. alcohol in 1 cc. urine.								
	0	1	2	3	4	5	Total known.	Unknown.	Grand total.
Total number of patients	35	45	58	64	35	13	250	250	500
"Acute alcoholic intoxication"	0	25	38	56	34	13	166	174	340
"Insufficient evidence"	35	20	20	8	1	0	84	76	160
Complications	20	23	21	27	11	3	105	111	216
Kept at hospital	19	14	29	38	25	13	138	133	271
Less than 35 years old	9	20	21	20	5	5	80	91	171
35 years and older	11	19	35	36	23	5	129	128	257
Admit drinking	15	26	30	30	15	2	118	102	220
Alcoholic odor on breath	14	37	49	49	32	13	194	198	392
Flushed face	5	23	29	28	8	4	97	91	188
Pupils dilated	7	25	20	27	12	5	96	109	205
Pupils contracted	3	6	14	8	5	5	41	20	61
Gait fair	9	13	15	6	0	0	43	22	65
Staggering gait	4	22	24	28	14	2	94	81	175
Unable to stand	0	0	14	11	18	11	54	69	123
Sway when standing	6	26	22	29	14	2	99	68	167
No sway when standing	7	6	9	2	0	0	24	12	36
Incoördinated	3	21	25	30	23	13	115	122	237
Coördination fair	10	11	14	4	0	0	39	17	56
Speech fair	9	12	13	1	0	0	35	21	56
Speech slurred	3	7	7	11	4	0	32	29	61
Speech confused	2	16	16	25	19	2	80	69	149
Unable to speak	0	0	11	6	12	11	40	45	85
Comatose	0	0	8	8	11	11	38	57	95

This viewpoint disregards completely the dictum of the Pennsylvania courts, in the case of Elkin *versus* Buschner, 16 Atl. 102-

104, where it was held that although a man may walk straight, attend to business and give no outward and visible sign of intoxication, yet if he is so affected by alcohol as to be excited, or not to possess that clearness of intellect which he would otherwise possess, he is suffering from acute alcoholism. In more than three score of instances which have come before it the Cincinnati Traffic Court has uniformly sustained the diagnosis of the Receiving Physician in these cases on the basis of the Ohio ruling.

TABLE II.—CLINICAL FINDINGS IN TWO HUNDRED AND FIFTY PATIENTS: PERCENTAGE INCIDENCE BY ALCOHOLIC CONTENT OF URINE.

	Mg. alcohol in 1 cc. urine						
	0	1	2	3	4	5	Total.
Patients examined	100	100	100	100	100	100	100
"Acute alcoholic intoxication"	0	56	66	88	97	100	67
Complications	57	50	36	42	31	23	43
Kept at hospital	54	31	50	60	71	100	55
Over 35 years old	55	49	62	64	84	50	60
Admit drinking	43	58	53	47	43	15	47
Alcoholic odor	40	82	84	76	91	100	78
Flushed face	18	50	50	44	23	31	39
Pupils dilated	25	56	34	42	34	38	40
Incoördinated	23	66	86	89	100	100	78
Staggering gait	36	60	45	62	44	15	48
Unable to stand at all	0	0	26	27	56	85	29
Sway when standing	46	81	54	68	44	15	59
Unable to speak	0	0	23	14	34	85	21
Speech confused	14	45	34	58	55	15	43
Speech slurred	22	20	15	25	11	0	17
Comatose	0	0	15	13	31	100	15

The Differential Diagnosis of Drunkenness. The courts have repeatedly held that the recognition of drunkenness is a matter of simple observation on which anyone may testify without any claim to expert ability or special training. The odor of alcohol, dilated pupils, flushed face and red nose, staggering gait, confused thick speech and boisterous behavior are commonly recognized features of this condition which are readily discernible.

But a person may be under the influence of alcohol to an extent that seriously affects his powers and behavior, especially in such a responsible position as driving an automobile, without presenting the entire common syndrome of drunkenness. On the other hand, not a few of the symptoms of drunkenness may be produced by other causes besides the drinking of alcohol. In addition to those individuals who habitually exhibit some of the characteristics generally associated with alcoholic intoxication, or who have some congenital or acquired defect which results in such manifestation, as in many cases of vasomotor instability, where dilated pupils,

flushed face and tachycardia may be constant findings, or in instances of tongue tie, stuttering or stammering, or of constitutional psychopathic inferiority with behavior disturbances, there is a multitude of pathologic conditions which may produce such symptoms.

Thus, any acute febrile disturbance, thyrotoxicosis or hypoglycemia resulting from hyperinsulinism, with dilated pupils, tremors, flushed face and tachycardia, and any number of local conditions affecting the eyes, mouth or limbs, may produce symptoms simulating those of acute alcoholic intoxication. So also may lesions of the central nervous system, such as skull fractures or intracranial hemorrhage following an accident, syphilis of the brain and cord, as locomotor ataxia or paresis, multiple sclerosis, brain tumor, Friedreich's ataxia, pernicious anemia with cord changes, early meningitis and so forth. Under the circumstances that generally prevail at the time of the examination for intoxication, confusing functional disturbances are apt to occur.

Of course, the differentiation between all of these conditions and acute alcoholic intoxication may readily be made in the majority of instances, by the presence or absence of other signs or symptoms essential for the diagnosis, but this is not always the case, and it must not be forgotten that a man suffering from one of these other conditions may, and frequently does, suffer also from the effects of drinking alcoholic liquors.

TABLE III.—PERCENTAGES OF TWO HUNDRED AND FIFTY PATIENTS SUSPECTED OF DRUNKENNESS, SHOWING VARIOUS SYMPTOMS ANALYZED ACCORDING TO ALCOHOLIC CONTENT OF URINE.

	Mg. alcohol per 1 cc. urine.					
Category.	0–1	1–2	2–3	3–4	4–5	5
Patients examined	14	18	23	26	14	5
Kept in hospital	14	10	21	27	18	10
Complications present	19	22	20	26	10	3
Acute alcoholic intoxication	0	16	23	34	20	7
Insufficient evidence	42	24	24	9	1	0
Under 35 years of age	12	25	26	25	6	6
Over 35 years of age	8	14	28	29	18	3
Admit drinking	13	22	25	25	22	2
Odor of alcohol	8	19	25	25	16	7
Flushed face	5	24	30	29	8	4
Dilated pupils	7	26	21	29	12	5
Unable to stand at all	0	0	26	20	34	20
Unable to walk straight	3	15	25	27	21	9
Unable to stand straight	4	16	24	26	21	9
Incoördination marked	2	17	19	23	18	11
Unable to speak at all	0	0	27	15	30	28
Speech confused	2	20	20	32	24	2
Speech slurred	9	22	22	35	12	0
Comatose	0	0	21	21	29	29

The Metabolism of Alcohol. Accurate determination of the concentration of alcohol present in the tissues of the subject offers a

promising means for ascertaining the degree of alcoholic intoxication. Numerous observers have reported that alcohol, like most other drugs, produces effects directly related to the amount of the substance in the tissues, and a number of them have attempted to use the concentration of alcohol in the blood as an index to the physiologic and psychologic state of the patient.

It has been shown that alcohol, taken by mouth, becomes quite rapidly distributed nearly uniformly throughout the body, reaching its highest concentration in the blood usually within an hour after it has been administered. It then gradually lessens as the alcohol is oxidized, which has been found to occur at the rate of about 5 gm. an hour in the average human subject. Since the concentration of alcohol in the urine is usually equal or slightly higher than that in the blood, and the amount excreted through the expired air also bears a constant relationship to the concentration in the blood, the determination of the alcoholic concentration of these excretions may also be utilized for the purpose of evaluating the degree of alcoholization.

TABLE IV.—ALCOHOLIC CONTENT OF THE BREATH AS AN INDEX TO INTOXICATION.

	Mg. alcohol per 2 liters breath.						
	0–1	1–2	2–3	3–4	4–5	5–	Total.
Acute alcoholic intoxication	3	10	25	19	8	3	68
Insufficient evidence . .	15	10	5	2	0	0	32
Total	18	20	30	21	8	3	100

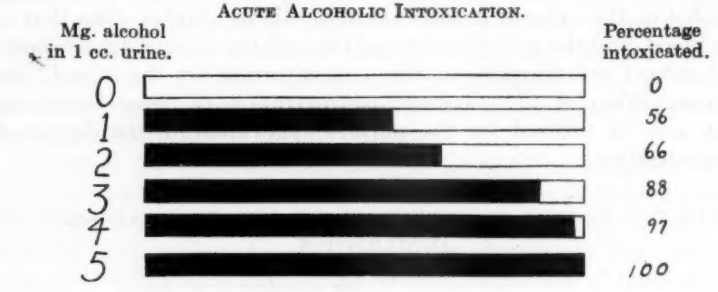
TABLE V.—ALCOHOLIC CONTENT OF BREATH COMPARED WITH THAT OF URINE.

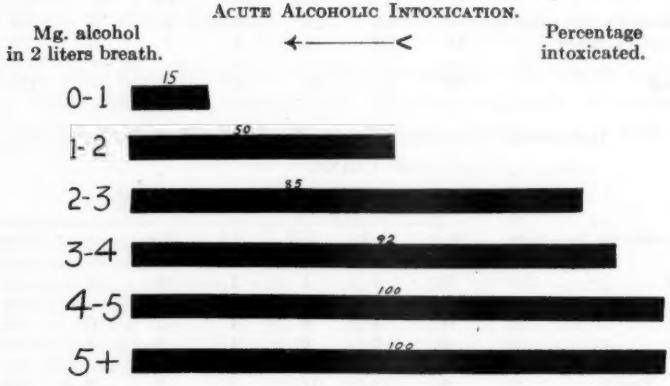
	Mg. alcohol per 2 liters breath.						
Mg. alcohol per 1 cc. urine.	0–1	1–2	2–3	3–4	4–5	5–	Total.
0–1	2	2	0	0	0	0	4
1–2	3	3	1	1	0	0	8
2–3	4	4	9	2	0	0	19
3–4	0	5	6	4	1	0	16
4–	0	0	0	1	1	1	3
Total	9	14	16	8	2	1	50

The Method Used. The methods used for the determination of alcohol in this study were devised and adapted particularly for this purpose after several months' preliminary investigation and testing of many different possible expedients, and numerous checks and control tests were thereafter performed to insure accuracy and reliability. Anstie's reagent, a solution of two-thirds of 1 per cent of potassium bichromate in concentrated sulphuric acid, was diluted with an equal quantity of distilled water and a current of air containing the alcohol in gaseous form bubbled through it. The color

change, from reddish-yellow to greenish blue, was then measured by comparison with a series of standards previously made up by the addition of known amounts of alcohol to 5-cc. portions of the reagent mixture in sealed tubes.

For ascertaining the concentration of alcohol in the urine, blood, spinal fluid or other tissues, 1 cc. of the specimen, which had been kept previously in a sealed vessel in an icebox, was placed in a test tube and a purified current of air bubbled through it at a moderate rate and then passed through 5 cc. of the reagent mixture of one-third of 1 per cent potassium bichromate in 50 per cent sulphuric acid, for ten minutes, both tubes being immersed in a boiling water bath.

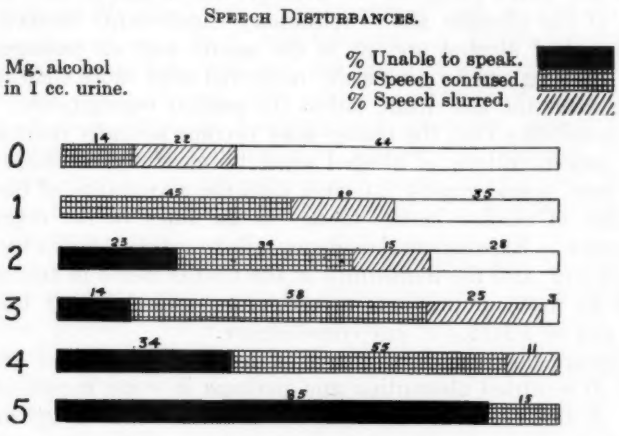


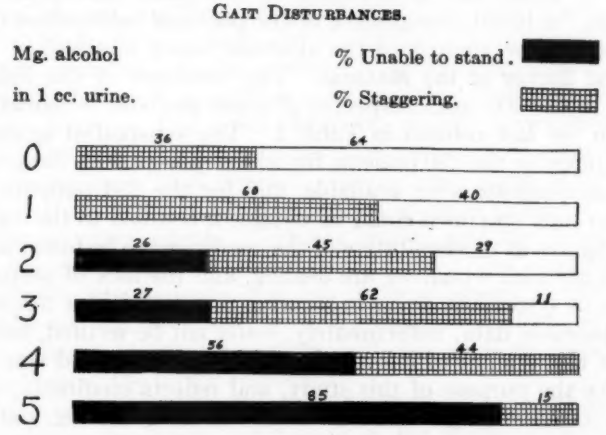


When acetone was present in the unknown solution it was removed by the addition of 1 cc. of Scott Wilson's alkaline mercuric cyanid reagent before aëration.

In these tests, in addition to noting the color changes by comparison with known standards containing 0, 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5 and 5 mg. of alcohol, respectively in 5 cc. of the mixed reagent, the amount of reduction of the bichromate, presumably due to alcohol, was determined more precisely by titration, as suggested by Cotte. This was done by adding to the heated and

aërated reagent solution 3 drops of a 1 per cent potassium ferricyanid solution as an indicator and then titrating with a standard solution of $\frac{N}{30}$ ferrous ammonium sulphate until the deep blue color was obtained. Each 2 cc. of the $\frac{N}{30}$ ferrous ammonium sulphate solution less than 10 cc. required for this titration represented 1 mg. of alcohol in the unknown solution when 1 cc. of the urine, blood or spinal fluid was used with 5 cc. of the mixed reagent.





For determining the concentration of alcohol in the breath the patient was asked to blow up a football, having a capacity of about 2000 cc. This air, while still warm, was then bubbled at a moderate rate through 5 cc. of the hot fresh mixture of equal parts of Anstie's reagent and distilled water. By adding the reagent and water together just before the air is bubbled through, the heat of dilution of the sulphuric acid provides all the heat required for the comple-

tion of the reaction. Whenever acetone was suspected the air was first passed through a warm solution of Scott-Wilson's alkaline mercuric cyanid reagent to remove the acetone before reaching the biochromate mixture. When the patient would not or could not blow up the football a mask with a two-way valve was applied to the face, so that all of the expired air was collected automatically in the football. All of these observations, of course, represent the expired air, which gives, on the average, about half of the concentration of the alveolar air. Preliminary experiments showed that the amount of alcohol present in the mouth and air passages following drinking can be practically neglected after more than fifteen minutes after the last drink, unless the patient regurgitates.

The possibility that the tissues may become actually resistant to higher concentrations of alcohol must be carefully considered, as this, if true, would greatly interfere with the acceptance of the concentration of alcohol in the tissues as an index to the degree of intoxication. Experimental evidence fails to support such a hypothesis, however, and the uniformity of the results found in this study, as well as those of previous investigators, make it very unlikely that it can be a factor of any consequence.

It appears that the development of tolerance to alcohol consists mainly in retarded absorption and perhaps in some increased oxidation of the alcohol absorbed, but that the tissues are always affected to about the same degree by the same concentration of alcohol in the blood, irrespective of the previous habituation of the individual or the amount of the alcoholic liquor imbibed.

General Survey of the Material. The incidence of the different findings in the 500 cases suspected of acute alcoholic intoxication is shown in the last column in Table I. The substantial agreement in the figures for the 250 patients for whom quantitative data on the urine examinations were available, and for the 250 patients from whom no such specimen could be obtained, testified to the validity of such figures as representative of the conditions to be found among the patients with whom we are dealing, and the lack of prejudiced selection or systematic errors in securing the material for this study. Much desirable data, unfortunately, could not be secured, but it is felt that the amount of information which was obtained was quite ample for the purpose of this study, and reflects creditably, under the circumstances, upon all who helped in its gathering, patients, policemen, attendants and physicians.

The large proportion of these subjects who had to be kept in the hospital, usually just for one night, is due in part to the fact that one-fourth of them could not stand at all, but were in stupor or coma from the alcohol imbibed, and also to the large number of complicating conditions, fractures, lacerations, stab wounds and other injuries, poisonings or disease. The proverbial drunkard's luck did not appear to be much in evidence in this series, since nearly half of

these patients were suffering from some such complicating circumstance.

The injuries which these patients sustained varied from slight abrasions to fatal depressed skull fractures. A large proportion were due to automobile accidents, where the patient was either driving the car or riding in it at the time of the accident, or where he had been hit while crossing the street. Many were hurt simply from falling on the ground as a result of the alcoholic ataxia. The suddenness with which the ataxia or stupor from alcoholism developed in some of these cases was remarkable. Personal encounters and injuries from fists, missiles and sharp or dull weapons or firearms were frequent and often serious. Poisoning or attempted poisoning was noted in a number of instances, generally with suicidal intent, with bichloride of mercury or veronal, 15 such bichloride attempts in intoxicated individuals having been noted in this hospital during the last fifteen months. Morphin addiction was also encountered.

The alcoholic beverages which were responsible for the condition of these patients varied widely, from expensive imported or old domestic whiskies, brandies and wines, pre-war stock and "prescription liquor" to the cheapest and most repulsive "rot-gut" moonshine, home-brewed beers, wines and other beverages, and denatured alcohol or alcoholic preparations intended for other purposes. These commercial and industrial denatured alcoholic preparations, "de-rail," as they were often called, included wood alcohol, solid alcohol (Sterno) and other preparations intended for fuel purposes, denatured alcohol of different formulæ and mixtures containing alcohol used as antifreeze mixtures in automobile radiators, rubbing alcohols, bay rum, Jamaica ginger (commonly called "jake"), vanilla extract and other flavoring extracts, patent medicines containing a high alcoholic content, and many other bizarre liquors. Unknown home-brewed liquors, given or sold by a "friend" or stranger, unclassifiable "Newport Moon" and denatured alcohol were the most popular beverages reported. The manifestations presented by the patients after any of these liquors, however, were so uniformly and invariably related to the ethyl alcoholic content of the urine or breath that no attempt was made to classify them on the basis of the liquor responsible.

No case of especially toxic effects from the presence of impurities or poisonous denaturing substances in the alcoholic liquors were noted, such as blindness from methylol, albuminuria from metallic poisons or hematemesis from gastric irritants, although these were often expected from the character of the beverages consumed. Deaths due to alcohol directly were rare, only 2 such deaths being noted among the 5 patients who died in the hospital, the other 3 deaths being due to hemorrhage, skull fracture, shock or other injuries.

The age incidence, predominantly in the fourth decade, suggests the importance of habits formed prior to the passage of the Eighteenth Amendment to the Constitution and the Volstead and other enforcement acts, in the production of the greatest number of these instances, only 1 individual below the age of twenty being included in this entire series.

The diagnosis of acute alcoholic intoxication was made in more than two-thirds of the cases, on the basis of the clinical findings alone, as discussed above. In quite a number of the 160 patients where insufficient evidence was recorded there were many symptoms and signs which a more rigorous interpretation of the term might have made the basis for a more direct diagnosis.

Less than half of the patients admitted drinking alcoholic liquors, and many of the most evidently intoxicated were the most vehement in denying such a possibility. The odor on the breath, however, was noted on the examination in more than 75 per cent of them, being present in almost every case where there was much additional evidence of intoxication. The flushed face and dilated pupils, so generally assumed to accompany the intoxicated state, were present in little more than one-third of these patients, according to the records, and noticeably constricted pupils were found in more than 12 per cent. Unequal pupils were encountered in more than a dozen patients, often giving rise to a suspicion of skull fracture, but this inequality generally disappeared as the patient became sober.

Inability to stand up at all was present in one-fourth of these cases, and more than half of the others were unable to walk without staggering or stand without swaying. In fact, a definite record that the patient could walk straight was present in only 13 per cent of this series, and a negative Romberg was even less frequently encountered, confirming the findings of Miles with the ataximeter that loss of control of station and equilibrium is one of the first effects of the ingestion of comparatively small amounts of alcohol.

Marked incoördination or the inability of the patient to place his finger on a desired spot with his eyes closed was present in 81 per cent of the cases where this symptom was sought, but in nearly half of the entire series no record was made of this test either way. Nearly one-fifth of the patients were in actual coma on admission and many others were stuporous and roused only with difficulty. In some instances, however, this was due to skull fracture, veronal overdosage or other cause, rather than to the alcohol itself.

Speech disturbances, particularly slurring or thickening of speech, or confused speech with twisting of syllables, was noted in nearly one-half of the patients, and nearly one-fifth of them were unable to speak at all. In less than 12 per cent of the entire series was the patient's speech recorded as normal.

Behavior disturbances were common, garrulousness, euphoria,

boisterousness and pugnacity being the usual condition in those who were not yet stuporous, but the variety of mental and nervous reactions was quite surprising, as may be seen from the list of adjectives used to describe their condition on the records. In addition to the 7 patients with actual or incipient delirium tremens, there were many nervous, quavering, tremulous, restless, and 1 in actual convulsions. Some were muttering, maudlin, moaning, crying, fearful, faltering, excited and disoriented, others maniacal, hysterical, hilarious, affectionate, confidential, profane, obscene, belligerent, loud and abusive, some had hallucinations, others were sleepy, sluggish, retarded and uncoöperative and many showed exaggerated motions and a tendency to overdo anything they attempted. Four of the patients attempted to substitute water or the alcoholic liquor for the urine specimen requested, but this deception was, of course, easily detected.

Vomiting was frequent, and some patients complained of nausea and vertigo. Loss of control of the urinary and anal sphincters were encountered, especially in those more deeply intoxicated, dribbling and incontinence being often seen; but quite a number of men had to be catheterized for acute urinary retention. Conjunctivitis, cyanosis, hiccough and double vision were only rarely noted.

Albuminuria was found in a half a dozen specimens and a positive Wassermann test was reported several times, despite the statement of Nichols and Craig that alcohol converts a positive to a negative Wassermann reaction. Acetonuria was noted 8 times, but acid urine was common, and a lowered blood carbon dioxid combining power was noted in every one of the 10 cases examined, especially on the day following the alcoholic stupor. The van den Bergh test for bilirubinemia was performed on 12 patients in alcoholic coma, and in every case was among the lowest normal figures, suggesting stimulation rather than depression of liver function in the acute stage.

Correlation of the Data. The relationship of the concentration of alcohol in the urine to the degree of intoxication of the subject is strikingly brought out in Tables I and II. Not one of the 35 patients having less than 1 mg. of alcohol in 1 cc. of urine was found to be intoxicated; but more than one-half of those having from 1 to 2 mg., three-fourths of those having from 2 to 4 mg. and nearly everyone having more than 4 mg. of alcohol in 1 cc. of urine was so diagnosed. Analysis of these groups shows even more striking relationships between the concentration of alcohol in the urine and the different symptoms upon which the clinical diagnosis is usually based.

Group 1, 0 to 1 Mg. The 35 individuals comprising Group 1, with an alcoholic concentration in the urine of less than 1 mg. in 1 cc. included both a number who had not taken any alcohol at all, and some who had imbibed small quantities. About one-half of them admitted drinking, and 40 per cent had the odor of alcohol

on their breath, but only a few showed the flushed face, dilated pupils, unsteady gait or slurred or confused speech of alcoholic intoxication, and in none was the combination of symptoms sufficiently marked to justify a diagnosis of drunkenness.

Group 2, 1 to 2 Mg. The group showing an alcoholic content of from 1 to 2 mg. offered the greatest difficulty in diagnosis, as this is apparently the borderline concentration, and it is here that tissue tolerance may, perhaps be conceded a rôle. A little more than one-half of this group was diagnosed "acute alcoholic intoxication," although more than 80 per cent had the odor of alcohol on the breath, and dilated pupils and flushed face was more often found among this group than in any other.

Group 3, 2 to 3 Mg. The group having a concentration of from 2 to 3 mg. of alcohol in 1 cc. of urine showed an increase in the incidence of nearly all of the symptoms of alcoholic intoxication, although even here nearly one-fourth of the patients were able to stand straight and speak clearly. Very few, however, did not show one or more of the symptoms of alcoholic intoxication, although the definite diagnosis was recorded in only two-thirds of them, and it was in this group that are first met cases of coma and inability to stand or talk, over 15 per cent of these patients presenting this picture.

Group 4, 3 to 4 Mg. The group having a concentration of from 3 to 4 mg. of alcohol in 1 cc. of urine contained only a few individuals who were not unmistakably intoxicated. Only 3 per cent of this group could stand without marked swaying and only 1 was recorded as speaking clearly. This was the degree of intoxication to which the largest number of our subjects attained, and represents most clearly the popular idea of drunkenness.

Group 5, 4 Mg. and Over. Above 4 mg. of alcohol per 1 cc. of urine practically all of the patients were in a state of actual alcoholic unconsciousness. The odor of alcohol was constant and deep, none of these patients, of course, could stand or walk straight and coördinate their movements, or even speak intelligibly and most of them were in absolute coma. It is interesting to note that in this group the constricted pupils and pale face were encountered almost as frequently as the reverse condition. This is the picture of the traditional "dead drunk," and if the concentration of alcohol in the blood were to reach 6 mg. or more death would be very apt to ensue.

TABLE VI.—ALCOHOLIC CONTENT OF SPINAL FLUID AS AN INDEX TO INTOXICATION.

	Mg. alcohol per 1 cc. spinal fluid.						
	0–1	1–2	2–3	3–4	4–5	5–	Total.
Acute alcoholic intoxication .	1	1	1	2	8	6	19
Insufficient evidence . . .	1	0	0	0	0	0	1

TABLE VII.—ALCOHOLIC CONTENT OF SPINAL FLUID COMPARED WITH THAT OF URINE.

Mg. alcohol per 1 cc. urine.	Mg. alcohol per 1 cc. spinal fluid. 0–1	1–2	2–3	3–4	4–5	5–	Total.
0–1	2	0	0	0	0	0	2
1–2	0	0	0	0	0	0	0
2–3	0	1	1	1	0	0	3
3–4	0	0	0	1	0	0	1
4–5	0	0	0	0	6	1	7
5–	0	0	0	0	2	5	7
Total	2	1	1	2	8	6	20

TABLE VIII.—ALCOHOLIC CONTENT OF BLOOD COMPARED WITH THAT OF URINE.

Mg. alcohol in 1 cc. urine.	Mg. alcohol in 1 cc. blood. 0–1	1–2	2–3	3–4	4–5	5	Total.
0–1	1	0	0	0	0	0	1
1–2	1	0	0	0	0	0	1
2–3	2	1	1	0	1	0	5
3–4	2	1	0	0	0	0	3
4–5	0	0	2	1	1	0	4
5–	0	0	0	0	1	2	3
Total	6	2	3	1	3	2	17

TABLE IX.—ALCOHOLIC CONTENT OF URINE ON MORNING FOLLOWING ADMISSION.

	Mg. alcohol per 1 cc. urine. 0.0–0.1	0.1–0.5	0.5–1.0	1.0–1.5	Total.
Number of patients	6	3	4	3	16

TABLE X.—ALCOHOLIC CONTENT OF URINE FOLLOWING NEW YEAR'S BEER PARTY.

	Mg. alcohol per 1 cc. urine. 0.0	0.1–0.5	0.5–1.0	1.0–1.5	1.5	Total.
Number of individuals	4	8	6	5	2	25
Per cent of total	16	32	24	20	8	100

TABLE XI.—EFFECT OF ALCOHOL IN MOUTH ON CONCENTRATION IN BREATH.

	Mg. alcohol per 2 liters breath. Exp. 1.	Exp. 2.
Before gargling	0	0
Immediately after gargling with absolute alcohol	5+	5+
Five minutes later	4	2.5
Ten minutes later	3	0.5
Fifteen minutes later	0	0

TABLE XII.—CHANGES IN ALCOHOLIC CONTENT OF URINE FOLLOWING DRINKING.

	During	1 hr.	2 hrs.	3–5 hrs.	5–10 hrs.	10–
No. 1. 5 oz. abs. alcohol		1.5	0.8	0.8	0.15	0.0
No. 2. 8 oz. abs. alcohol		1.1	2.0			
No. 1. 12 glasses beer	0.7	0.5	1.0	...	0.2	0.0
No. 2. 12 glasses beer	0.5	1.2	...	...	0.4	
No. 3. 12 glasses beer	0.5	0.5	0.8	1.0		

The Breath as an Index to Alcoholism. The concentration of alcohol in the urine cannot be accepted as an absolutely accurate indication of the alcoholic concentration in the tissues of the patient unless we know exactly the time period during which it was secreted, since it would, on the whole, represent the summation of all of the different concentrations existing during the period of secretion. There is, however, some resorption of alcohol from the bladder if the concentration of alcohol in the urine becomes much higher than that in the blood, as shown by Nicloux and others. Southgate and Carter met this objection by having the subject void on admission and again fifteen minutes later, and taking the latter sample as representing the concentration of alcohol in the patient during this interval. We have had some difficulty in securing even one specimen of urine from our patients, as catheterization is usually not justified in such cases, and there is often insufficient time for further procedures, and so we sought for some simpler scheme for this determination.

The concentration of alcohol in the breath, as shown in Chart II and Tables IV and V offers a very satisfactory substitute. As soon as the residual alcohol still in the mouth is removed, which, as shown in Table XI, usually occurs within fifteen minutes after imbibition in the absence of regurgitation, the concentration of alcohol in the breath approaches a fairly consistent relationship to that in the blood, since alcohol passes through the lungs very easily in either direction. Thus less than 16 per cent of those having less than 1 mg. of alcohol in the 2 liters of breath were found to be intoxicated, one-half of those having from 1 to 2 mg. and more than four-fifths of those having from 2 to 4 mg. and every person having more than 4 mg. in the breath was so pronounced. Although, as may be expected from the considerations given above, the concentration of alcohol in the breath and in the urine, as shown in Table V, is not identical, yet it is remarkable how closely they are in agreement.

The concentration of alcohol in the breath following gargling with absolute alcohol, when practically none of it is swallowed, is shown in Table XI. This, of course, represents the results when the breath is blown out through the mouth and would be much lower if the breath were taken through the nose by a face mask. It is surprising, however, how rapidly alcohol appears to leave the buccal surfaces in the absence of vomiting, belching, hiccoughing or other interfering phenomena.

Relationship of Urinary Alcohol to Amount Imbibed. Additional observations under controlled conditions, as shown in Table XII, allowed us to follow the changes in the alcoholic content of the urine at different intervals following the ingestion of known amounts of alcohol. It may be noted that the acme, or period of highest concentration came earlier in Subject 1, who had comparatively low tolerance to alcohol than in Subject 2, who was more accustomed to such beverages, and also that the concentration rose more

rapidly in both following the taking of absolute alcohol than after the more dilute alcohol in the form of beer, in agreement with the more extensive studies of Mellanby. In these subjects there was no alcohol remaining in the urine more than twelve hours later. In the cases coming in in stupor, however, the specimens of urine taken from eight to twelve hours later, as shown in Table IX, showed a small but quite definite amount remaining in the urine in most instances.

A New Year's party of young men gave us an opportunity to learn something about the average tolerance in this group in relationship to beer drinking. The beer contained about 5 per cent alcohol. The number of glasses of beer consumed varied from 1 to 15, generally about 8, giving an average consumption of about 3 ounces of alcohol. The average concentration of alcohol in the urine in these young men, taken on the first voiding following the party, is given in Table X, and emphasizes the variability of tolerance in different individuals.

The Alcoholic Content of the Spinal Fluid. The concentration of alcohol in the spinal fluid was determined in 20 instances, and, as may be seen in Table VII, was very close to that of the urine. In 16 of these patients, or in 75 per cent of the cases where spinal puncture appeared to be indicated, it was more than 3 mg. per cubic centimeter. Increased pressure of the spinal fluid was usually found in these cases and the patients often roused considerably and sometimes completely immediately following the puncture.

Conclusions. In view of the difficulty in making the diagnosis of acute alcoholic intoxication from the clinical evidence alone, as may be confirmed from a review of the data in the cases above presented, and in view of the constancy of the findings as to the relationship of the concentration of alcohol in the urine and breath to the degree of alcoholic intoxication of the patient, it is concluded that the examination of persons to determine the state of alcoholic intoxication should in every instance include some such quantitative estimation of the amount of alcohol present in the urine, breath or body fluids.

It is not suggested that such a test should supersede and entirely replace all of the other clinical evidence presented, but, as with any other laboratory procedure it should be interpreted in the light of all of the findings in the individual case. A study of the results in the series of cases just presented, however, as well as those reported by Nicloux, Widmark, Schweisheimer, Miles, Mellanby, Southgate and Carter, and many others, leads to the conclusion that the alcoholic concentration of the urine, breath or body tissues constitutes the most reliable single factor in arriving at a correct diagnosis of the degree of acute alcoholic intoxication of a patient.

NEW CLINICAL ASPECTS OF ALCOHOLISM.

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Introduction. Since the advent of prohibition one sees alcoholism that differs in many respects from that of former years. Various authors have suggested causes for the toxicity of bootleg liquors, and it is quite probable that with the consumption of such a variety of alcoholic liquids today, one is confronted with poisoning from other substances in addition to alcohol. Suffice to say, however, that the patients sick from alcohol today are different, and it is our aim to compare the present-day patient with the one of former years. This paper is based on a study of 198 cases of alcoholism treated at the Lakeside Hospital from 1921 to 1926 inclusive. The 198 cases were disposed as follows:

Acute alcoholism	51
Chronic alcoholism	61
Neuritis	18
Cirrhosis	14
Delirium tremens	5
Alcohol plus other poisons	5
Alcoholism plus accidents	44

These patients were studied by usual and ordinary clinical methods of description and the data summarized—in the same way that preprohibition alcoholism was studied and recorded in medical literature.

Acute Alcoholism. Chart I is a summary of 51 cases of acute alcoholism. It is seen that 30 (63 per cent) of these were admitted in an unconscious condition, most of whom were found lying on the street by the police. Before prohibition, out of 51 cases, only 31.5 per cent were brought in in this condition. All of these patients were deeply unconscious and could not be aroused to any extent even with painful stimuli.

In regard to the temperature, it is seen that only 16 (21.5 per cent) had subnormal temperature. All of the cases had been lying exposed to the weather, a fact which must have played a part in causing low temperatures. Of the other cases, 27 (53 per cent) had a temperature between 37° and 38° C. Of the 8 cases that had a temperature above 38° C., 6 were complicated by acute infections and 2 had fever without evident infection. Most of the cases with initial subnormal temperature had a slight fever during the stay in

the hospital. We must, therefore, conclude that acute alcoholism today is accompanied by fever, usually, however, mild. This is contrary to the text-book opinion that acute alcoholism is usually accompanied by a subnormal temperature.

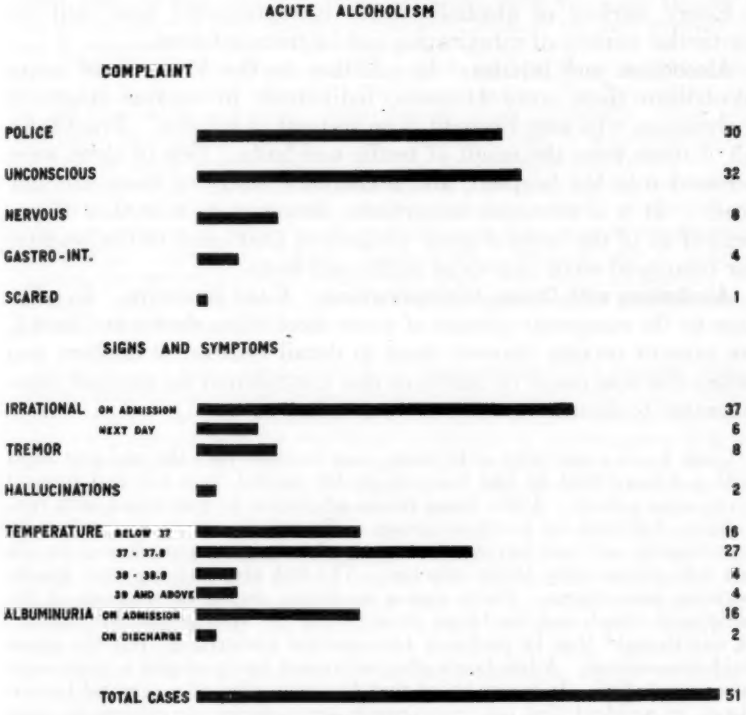

CHART I.

In this series of cases 16 (31 per cent) had albuminuria on admission. In all but 3 cases the urine was normal again twenty-four hours after admission. Of these 3 cases 1 had chronic nephritis, 1 had mild cardiac decompensation, while 1 apparently started an attack of acute hemorrhagic nephritis which lasted several weeks and which was followed by definite impairment of kidney function. Albuminuria was not considered a symptom of prepro-hibition alcoholism, but MacNider[1] has shown that a fermented mixture made from cornmeal and sugar develops a nephrotoxic substance. Such substance may have caused albuminuria in some of our cases, but we have no reliable information about the kind of beverage consumed. Although a large percentage of our cases showed albuminuria, kidney damage was slight and the urine was usually normal within twenty-four hours. Acute injury of the kidney was never prominent in cases of alcoholism before prohibition.

In addition to the data tabulated, study of this group showed the average age to be forty-six years; 46 were men and 5 women. Pulse, respirations, blood-pressure and leukocyte counts showed nothing significant. The average stay in hospital was between two and three days. Four died and the rest got well.

Every variety of alcoholic drink is represented here, but no particular variety of intoxication can be demonstrated.

Alcoholism and Injuries. In addition to the 51 cases of acute alcoholism there were 44 cases, individuals in various stages of inebriation, who were brought in on account of injuries. Practically all of these were the result of traffic accidents. Few of them were referred into the hospital, and a complete study of them was not made. It is of economic importance, however, to note that 46 per cent of all of the cases of acute alcoholism that came to the hospital for treatment were victims of traffic accidents.

Alcoholism with Unusual Complications. CASE REPORTS. In addition to the composite picture of acute alcoholism shown in Chart I, we present certain unusual cases in detail because alcoholism was either the sole cause of illness or else contributed an unusual complication to disease.

CASE I.—A man, aged sixty years, was brought into the accident ward with a history that he had been drunk for several days but had sobered up to some extent. A few hours before admission he was seized with convulsions followed by unconsciousness. He was found to be profoundly unconscious and was having clonic convulsions more pronounced on the left side about every thirty minutes. The left arm and leg were spastic between convulsions. There was a moderate degree of sclerosis of the peripheral vessels and the blood pressure was 184 systolic and 84 diastolic. It was thought that he probably had cerebral hemorrhage, but the spinal fluid was normal. A few hours after admission he developed a pulmonary edema and died. It is our belief that this man died of a cerebral hemorrhage, an accident that not uncommonly accompanies convulsions in acute alcoholism. There was no autopsy.

CASE II.—A man, aged thirty-three years, had been a diabetic for six years and had been doing well on a diet with insulin. Two days before admission he went on a drinking spree. A few hours before admission he became nauseated, vomited several times and became semicomatose. On admission, he was semicomatose. The heart rate was 140 to 160, the pulse of poor volume and the systolic blood pressure 90. After the administration of insulin, glucose, fluids and stimulants, his condition was somewhat improved, and the morning following admission he was rational enough to answer questions. The blood sugar which was 0.5 per cent on admission was 0.13 per cent at this time. The temperature remained around 39° C. during his entire stay in the hospital. His apparent improvement was only temporary, and he soon became comatose and died on the morning of the second day. The clinical diagnosis was diabetic coma complicated by alcoholism. At autopsy acute gastritis and acute nephritis were found. The gastric mucosa contained several hemorrhagic areas and the acute nephritis was quite marked. Such a change one would not expect from alcohol alone, and in our belief we were dealing with some poison other than alcohol.

CASE III.—This is another instance of death after acute alcoholic intoxication in a manner suggesting an additional poison. This patient, a man, aged forty-four years, entered the hospital complaining of nervousness. He had a history of having taken bootleg whisky over a period of several days. He appeared an ordinary healthy man, but extremely restless, apprehensive and with generalized tremors. The heart and lungs were normal. There was a definite lead line on the gums, and there was slight atrophy of the musculature of both hands—presumably from an old lead neuritis (he was a painter by trade). The temperature on admission was 39° C., the pulse 100 and the blood pressure 155 systolic and 85 diastolic. The urine showed a trace of albumin and a few hyalin casts. The hemoglobin was 75 per cent; white cell count, 6700; red-cell count, 2,554,000. Soon after admission the patient became wildly delirious, and it was necessary to administer large doses of sedatives. His temperature rose to 40° C., and he died about eighteen hours after admission. No cause for the temperature could be found on examination. Autopsy revealed cloudy swelling of the liver and kidneys, a mild chronic nephritis and chronic passive congestion and a slight amount of edema of the lungs. Nothing very definite to explain this patient's clinical picture and death was found at autopsy, but we must consider the possibility of a combination of acute alcoholism and plumbism as the cause of death.

CASE IV.—A man, aged thirty-four years, entered the hospital with a history that for two weeks he had been consuming large amounts of whisky daily. At the time of admission he complained of nervousness and backache. On examination, he was found to be active, apprehensive and was having generalized tremors. The pulse was rapid (140), grossly irregular and there was a pulse deficit. A diagnosis of auricular fibrillation was made which was confirmed by an electrocardiogram. The following morning he was perfectly sober and the heart was normal. An electrocardiogram at this time showed a normal mechanism. This patient had no history of any cardiac disturbance, and he had had no previous similar experiences, and there was no other evidence of cardiac disease. Since this apparently came on while he was under the influence of some intoxicant and disappeared when he became sober, we feel that the intoxication in all probability was the cause of this disturbance in the cardiac mechanism, though we know of no similar instances. This patient had been drinking bootleg whisky with the addition of one bottle of hair tonic.

CASE V.—A man, aged thirty-eight years, was brought in unconscious, very cold (temperature, 35° C.), cyanotic with an odor of alcohol on his breath. The stomach was lavaged and the patient aroused enough to give a history that he had consumed a considerable quantity of alcohol which he knew to be denatured. A few hours after admission the temperature had risen to 40° C., and remained for thirty-six hours until his death. He began to have marked diarrhea with mucus, bright red blood and a small amount of pus in stools. White-cell count was 6800. Autopsy revealed a marked enterocolitis involving the terminal 12 inches of the ileum and the entire colon. The colon showed the most pronounced changes, there being marked swelling and reddening of the mucosa, many pin-point hemorrhages and numerous small superficial ulcerations. The appearance of the colon was unlike an ordinary infectious ulcerative colitis and it is our belief that denatured alcohol was the cause.

CASE VI.—A man, aged forty-four years, was brought to the hospital by the police, profoundly unconscious, cyanotic and requiring artificial respiration for a time. There were white patches on his tongue and buccal

mucosa that suggested phenol burns. A bottle labeled "denatured alcohol" was found in his pocket. The stomach contents had the odor of phenol. This patient made a good recovery and was discharged seven days later feeling well except for the burns in his mouth which had not entirely healed.

CASE VII.—A man, aged thirty-five years, immediately after drinking some bootleg whisky, began to have pain in his chest. The pain persisted for days and was greatly aggravated by swallowing, and the patient finally came to the hospital for relief. He improved to some extent on a diet consisting chiefly of milk, but his difficulty in swallowing did not disappear. A fluoroscopic examination made about four weeks after the onset showed two strictures of the esophagus, one about 3 cm. above the cardia and the other about 10 cm. above this. These strictures have been dilated at frequent intervals since, and at the present time the patient is doing very well on a soft diet. We have no clue to the caustic that was responsible for the stricture of the esophagus.

In summing up acute alcoholism then, it is seen that unconsciousness is common and probably comes on early, a febrile reaction is present in most cases, and a large percentage shows a transient albuminuria. These new aspects of acute alcoholism may be explained altogether as depending on the dosage of alcohol, for we have no proof of other poisoning. The very unusual and bizarre symptoms as shown in the detailed case reports are certainly due to alcohol plus other poisons, but just what poisons are most common we cannot say.

Wood Alcohol. We have no way of knowing with certainty how many of the patients we report were poisoned with wood alcohol, there being no easy and sure way to recognize the effects of wood alcohol alone or mixed with ethyl alcohol; nevertheless the records show that in this series there were only 3 patients who were described by the hospital staff as showing signs of poisoning by wood alcohol, although many of them gave a history of having drunk denatured alcohol. Two cases were seen prior to 1921, when denatured alcohol contained 10 per cent wood alcohol; another was seen later, when but 2 per cent was used.

Of these cases, 2 were brought in semiconscious by the police who had found them lying in the street. In both cases there was odor on the breath suggestive of wood alcohol, and this was quite in evidence in the gastric contents. The patients otherwise did not differ from any other ordinary case of alcoholic intoxication. There was no cyanosis in either case. They were both given a gastric lavage in the accident room and referred into the hospital. Both were "discharged against advice" on the day following admission. At the time of discharge the eyegrounds appeared normal, but both complained of blurring vision, and were unable to read ordinary print. Neither of these patients returned, so we are not aware as to the final outcome.

A third patient, a man, aged fifty-eight years, entered the hospital with the complaint of blindness. He had been consuming alcohol

daily for a number of years, and since prohibition had been drinking practically anything he could get that had a high alcoholic content. Four months before admission he noticed an impairment of his vision, and at the time of admission he was almost totally blind—being able only to perceive light faintly. He was in the hospital about two months. During the first few weeks of his stay his vision improved gradually until he finally was able to distinguish moving objects. The eyegrounds at all times showed a marked optic atrophy, and there was no change accompanying his improvement. His improvement was only temporary; he soon lost his sight entirely, developed a marked psychosis and died shortly afterward. Permission for an autopsy was refused.

Chronic Alcoholism. There were 24 cases (15.5 per cent) that could definitely be classed as chronic alcoholics as determined by a history of long and steady drinking. A few of the 24 were acutely intoxicated when admitted to the hospital, but, nevertheless, are listed here as chronic.

In regard to the kind of alcohol consumed, all but one claimed to be drinking anything that they could obtain. It was difficult to determine the length of time they had been drinking, but in only 2 cases was there a definite history of this period being shorter than ten years. The average age was about fifty years. Their habits of drinking varied considerably from those of the old "tipster," who drank small amounts of liquor daily. Most of these individuals were unable to drink daily, but their method of drinking was to indulge in frequent sprees as determined by the supply. The number of cases that entered the hospital acutely intoxicated supports this statement. The details of this group are too complex to be tabulated and no conspicuous feature emerges from the general picture.

Eight of these patients entered the hospital with the complaint of nervousness. These individuals were nervous, apprehensive, shaking and appeared on the verge of delirium tremens. They were excitable, and it was necessary to administer sedatives freely. None, however, had any delirium and none of them went into a state typical of delirium tremens. This picture is apparently common in chronic alcoholism of today and may be said to represent a mild form of delirium tremens, as the tremors are always marked. There is no delirium, however, and typical delirium tremens may not develop.

We are amazed, in contemplating this group, by the enormous amounts of alcohol consumed and scanty signs of injury therefrom.

Delirium Tremens. In spite of the fact that a number of chronic alcoholics seemed on the verge of delirium tremens, there were only 5 cases that could definitely be put in this category. During the five years preceding prohibition there were 20 cases. Other writers have called attention to the fact that delirium tremens does not

occur as frequently as it formerly did and our figures support this observation. The reason for this is obscure, but a clue can probably be found in consideration of the chronic alcoholics of today. Since the basis of delirium tremens is chronic alcoholism, the cause for this decrease may be due to the fact that the daily "tipster" has disappeared and given way to an individual who indulges in frequent sprees. The cases of delirium tremens that were seen did not differ in any respects from the accepted clinical picture of this condition.

Alcoholic Neuritis. Kammon[2] has very recently made the statement that alcoholic neuritis of today differs from that antedating prohibition. He claims that former alcoholic neuritis was characterized by motor weakness, loss of reflexes, muscular atrophies and trophic disturbances, while today one sees patients complaining of exquisite hyperesthesia, who, on physical examination, are found to have little reflex changes or motor involvement and no sensory changes other than hyperesthesia. It is extremely difficult to make a comparison between present-day alcoholic neuritis and the former type, because of the protean aspects of the latter as described in medical literature.

ALCOHOLIC NEURITIS

CASE		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
COMPLAINT	WEAKNESS			X	X		X		X	X		X	X	X		X			X	10
	PAIN		X			X	X	X					X	X						6
	PARAESTHESIA		X										X	X		X		X	X	6
REFLEXES	ABSENT	X		X	X			X	X	X				X			X		X	9
	RETARDED												X			X	X			3
	NORMAL						X											X		2
	EXAGGERATED		X								X	X								3
MUSCULAR ATROPHY		X			X			X	X	X	X		X	X						8
ATAXIA	PROXIMAL			X	X			X	X		X						X			6
	DISTAL				X						X									2
SENS. DISTURB.	PREVIOUS		X	X	X				X				X	X		X		X	X	9
	PRESENT	X	X	X	X		X	X		X	X	X	X	X					X	12
PAIN			X		X	X	X	X						X						6
PARESIS					X		X	X	X	X	X	X	X	X	X	X		X	X	13
TREMOR			X															X		2

CHART II.

Chart II summarizes the 18 cases of neuritis in this group, which is 11.6 per cent of the whole. From this table it is seen that in 10 cases there was a complaint of weakness, pain was complained of in 6 cases and 6 complained of paresthesia. Weakness then

constituted the complaint in over one-half of the cases, while only one-third complained of pain.

Physical examination showed in 13 cases a definite paresis of some muscle group. In 12 cases there were definite sensory disturbances, but in only 9 was there a history of definite sensory changes. In 9 cases there was an absence of deep reflexes and in 3 cases reflexes were definitely retarded. From our 18 cases it is impossible to say that present-day neuritis is different insofar as the motor or sensory symptoms predominate.

There was involvement of the extremities in 15 cases; in 5 of these one or both of the lower extremities; 1 case had involvement of a single upper extremity and in 9 cases there was involvement of all extremities. The seventh cranial nerve was involved alone in 1 case and in 2 other cases there was involvement of this nerve in addition to changes in the extremities. We have seen only 1 case that is similar to the case described by Kammon. This patient had involvement of the gluteal nerve with no sensory disturbances other than a slight hyperesthesia. Two of these cases had involvement of the second cranial nerve. In the rapidity of onset and duration of disability, we may possibly find a new aspect of neuritis, for but 3 cases of the 18 had a period of three to four months before coming to the hospital. In the remaining 15 the complaint was present from one day to four weeks, which seems very short as compared with the older concept of neuritis. The period of hospitalization was also very short, and, as far as we are able to determine, so was the period of disability. Because we were unable to keep our patients or to trace them, we think they were not disabled as long as is commonly the case. This is mere conjecture and our data furnishes no proof.

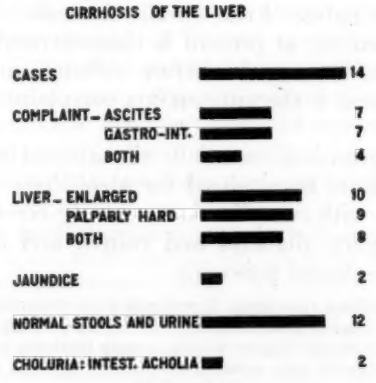

CHART III.

Alcoholic Cirrhosis. Out of this series of cases there were 14 cases (9 per cent), summarized in Chart III, of cirrhosis of the liver. These cases presented no unusual aspects as far as we could deter-

mine. This disease is usually found in the fifth and sixth decade of life. Of our cases all were practically of this age, the ages being between forty-eight and sixty-nine years, except in one instance where the patient was only thirty-five years of age. All but one case had a history of taking alcohol daily. The period of years liquor was used varied from eight to forty. Authors agree that ascites is present in about 50 per cent of the cases. In our cases ascites was present in exactly 50 per cent. Jaundice was present in only 2 cases; 1 of these had acute catarrhal jaundice and 1 bronchopneumonia. The length of hospitalization varied from two days to seven and a half months. In the uncomplicated cases no improvement was noted. Death occurred in 3 instances; 1 of these was uncomplicated, while of the other 2 chronic nephritis complicated 1 and bronchopneumonia the other. So far as we have been able to ascertain, the picture of alcoholic cirrhosis at the present does not present any striking differences from that seen before prohibition.

Conclusions. 1. Acute alcoholism today is characterized as a rule by early loss of consciousness in a large percentage of cases, a slight febrile reaction and a transient albuminuria in addition to other signs of alcoholic intoxication. Bizarre pictures and unusual complications are not uncommon and sudden death occasionally occurs.

2. The very unusual clinical aspects of alcoholism as shown by 6 cases reported in detail are due probably to other poisons than alcohol.

3. Alcoholism frequently causes traffic accidents.

4. Chronic alcoholism has changed in the respect that the daily "tipster" has given away to an individual who indulges in frequent sprees, but not daily drinking.

5. Delirium tremens is relatively rare at present—probably due to the change in the habits of the chronic alcoholic.

6. Alcoholic neuritis at present is characterized by rapid onset, usually less than four weeks before definite muscular weakness appears. Weakness is the outstanding complaint in 72 per cent of the cases.

7. Alcoholic cirrhosis is essentially the same as before prohibition.

8. Of 154 patients hospitalized for alcoholism, 8 died: 4 from acute alcoholism with complications, namely cerebral hemorrhage, lead encephalopathy, diabetes and colitis; and 3 from cirrhosis; and 1 from wood-alcohol poisoning.

NOTE.—Since compiling this study 3 patients with alcoholism and pellagra have come to our notice—2 being autopsied and 1 surviving. In all 3 there was long-continued and intense use of corn liquor, which, in each instance, largely supplanted the usual diet. It is our belief that alcohol, by interfering with the diet, precipitated the onset of pellagra.

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UNDULANT FEVER (BRUCELLA MELITENSIS).

With Three Cases Each, Due to Bovine and Goat Origin.

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Within the past few years there has been an increasing number of reported cases of Brucella melitensis infection in the United States, indicating a more common recognition of this disease. A few of the earlier reports dealt with cases in which goat milk was the infecting source. The remainder of the cases reported have been infected with the bovine strain. Therefore, it was thought worth while to report 6 further cases, 3 of bovine origin, and the remainder presumably contracted through the use of goat's milk.

Human infection with Brucella melitensis, occurring in the United States, was first described by Craig[1] in 1906. Endemic Malta fever was reported in the Southwest, where goat raising is an important industry, by Gentry and Ferenbaugh[2] in 1911, and by Yount and Looney[3] in the following year. Watkins and Lake[4] reported an epidemic of Malta fever in Arizona, in 1922, with goat milk as a source of infection. The first case of human infection traced to Bacillus abortus from bovine origin was reported by Keefer[5] in 1924. Since then, there has been an increasing number of cases reported. Those from the bovine source have been collected from the literature by Evans[6] in 1927, and, therefore, will not be referred to in detail. This collected group contained 21 cases. Five more cases were reported in the same year by Hull and Black.[7]

Case Reports. The first 3 cases of this report were among the admissions to the University Hospital within the past year. The patients were residents of Michigan and had resided in their respective communities for at least some years. Unquestionably the source of infection in these instances was cow's milk.

Case I.*—W. B., aged twenty-seven years, a barber, entered the hospital in March, 1927. Seven weeks before admission the patient became ill with chills, fever and generalized aching. He improved after a few days, but for the past six weeks has noted palpitation, nervousness and insomnia. Night sweats had been present for the past four weeks. Two weeks ago there was severe pain in the right hip. He had lost 22 pounds of weight.

Physical examination showed undernourishment. The thyroid was palpable. Lymphadenopathy was present in the anterior and posterior cervical chains, axillary, epitrochlear and inguinal regions. The glands varied in size from a pea to a small nut. The liver and spleen were not palpable.

* Case I was from the service of Dr. Henry Field.

In the first eleven days of hospitalization the evening temperature ranged from 99° to 102.5° F.

Technical Findings. The Wassermann test was negative on two occasions. The first basal metabolism reading was + 27 per cent, the second was + 7 per cent. Roentgenologic examination of the lungs was negative. There was no anemia. The white cell counts ranged from 5000 to 6500; smear showed 48 per cent lymphocytes and 42 per cent neutrophils. The Widal test for the typhoid and paratyphoid organism was negative. Brucella melitensis agglutinated in a dilution of 1 to 1280. Two blood and one urine cultures were negative for the organism.

CASE II.—C. G., aged forty-seven years, farmer, entered the hospital June, 1927. Three months before he had noted malaise and an afternoon temperature of 99° to 102° F. Three weeks later he developed night sweats and had been confined to bed the last two weeks.

Physical examination was essentially negative except for pea-sized lymph glands in the cervical chains bilaterally. The liver and spleen were not palpable.

Technical Findings. The Wassermann test was negative. Roentgenologic examination of the lungs showed an old pleurisy at the right base. The urine was negative. There was no anemia. The white cell count was 7100 with 54 per cent neutrophils and 44 per cent lymphocytes. The Widal test was negative for the typhoid group. Brucella melitensis agglutinated in a dilution of 1 to 320.

CASE III.—E. S., aged forty years, farmer's wife, entered the hospital in July, 1927. Two months before there had been an onset of fever and severe headaches at night. This was accompanied by nervousness, anorexia, malaise, a loss of 20 pounds of weight. There had been drenching night sweats since the onset. For the past two weeks the fever had been present every night. Before then the temperature was 100° to 104° F. each night for several nights, with an afebrile period of some days between. There was often a severe chill in the early morning. (The provisional diagnosis of Brucella abortus infection was made in the out-patient department.)

Physical examination was essentially negative, the liver and spleen not being palpable. While the patient was in the hospital, the evening temperature varied from 100° to 102° F.

Technical Findings. The Wassermann test was negative. Roentgenologic examination of the lungs was negative. There was no anemia. The white cell count varied from 5850 to 8700, with 68 per cent of neutrophils in the smear. The urine was negative. The Widal test was negative for the typhoid group of organisms. Brucella melitensis was agglutinated in a dilution of 1 to 320. A blood culture was negative for the organism.

A fourth patient, a farmer, was seen in the home while visiting with a consultant.

The remaining 3 cases were seen in Salt Lake City, Utah, in 1923–1924. These patients had been referred from the mining region where the foreign population predominates. Goats are kept by the households of foreigners; further, goat raising is an industry in portions of the state. A survey by the state veterinarian and his staff showed the presence of Brucella melitensis infection among the goats. (The first 2 of the following 3 patients were seen and followed in the service of Dr. M. M. Critchlow of Salt Lake City.)

CASE IV.—D. S., aged eleven years, Italian schoolgirl entered the hospital September, 1923. In July she had been ill for three weeks with fever, the local physician making a diagnosis of typhoid fever. The temperature returned to normal. Since then, the patient had had several relapses of fever, with an afebrile period of about ten days between. She complained of pain in the lower third of the right thigh, and there had been swelling of the right knee. The patient had used goat's milk.

Physical examination showed a bilateral cervical lymphadenopathy. The liver was not palpable, but the spleen was felt 3 cm. below the costal margin. Otherwise the examination was negative. While in the hospital the evening temperature varied from 100.6° to 101.4° F.

Technical Findings. The Wassermann test was negative. Roentgenologic examination of the lungs, right femur and knee were also reported negative. The urine was negative. There was no anemia. The white blood cell count was 6000. An organism which was culturally and morphologically identical with Brucella melitensis was recovered from the urine twice and from the blood once by culture. The patient's serum agglutinated Brucella melitensis in a dilution of 1 to 240.

CASE V.—M. V., aged forty-three years, Italian housewife, entered the hospital January, 1924. Eight months before the patient developed abdominal pain, cough and fever; the attending physician made a diagnosis of typhoid fever. From that time, the patient had been ill most of the time with malaise, chills, fever, severe sweats, and loss of weight. At times she had been free of symptoms for several weeks at a time. The patient had frequently eaten cheese made of goat's milk.

Physical examination showed a poorly nourished female, with pallor. A few râles were heard at the lung bases. The liver extended to the level of the umbilicus and was tender. The spleen was palpable 6 cm. below the costal margin. During hospitalization the temperature ranged from normal to 102° F. in the evening.

Technical Findings. The Wassermann was negative. The urine showed a trace of albumin. The hemoglobin was 53 per cent, the red cell count 3,600,000, and the white cells from 4400 to 6000. A differential count showed 44 per cent neutrophils and 54 per cent lymphocytes. An organism identical with Brucella melitensis was isolated by urine and blood culture. Serum rapidly agglutinated known Brucella melitensis, as well as the organism isolated by culture, in a dilution of 1 to 100. (No higher dilution was tried.)

CASE VI.—R. S., aged fifteen years, an American schoolgirl, entered the hospital July, 1923. Eleven months before, in August, 1922, the patient was ill for three or four days with a temperature of 103° F., malaise, and generalized aching. She was then apparently well until September 20, 1922, at which time she developed a fever of 104° F., the wave of fever persisting for five weeks. At this time a diagnosis of typhoid fever was made. She then improved but was not as well as formerly. In February, 1923, she was again severely ill with a temperature as high as 103°, anorexia, "rheumatism," general aching and pains in the joints. From March 15 to May 1, the patient had another wave of fever, being in bed, and suffering from severe pain in the left subcostal region, made worse when lying on the right side. Fever was as high as 103.5° F. At this relapse, she also complained of pains in the joints, especially the knees and hips. She then improved until June 21, 1923, when she again became febrile. The periods of high fever were always accompanied by chills and drenching sweats; there had been a loss of 20 pounds. The attending physician first noted

hepatic enlargement in May. The patient lived in close association with the Italians at the mining camp and had admitted the use of goat's milk.

Physical examination showed an emaciated pale girl. The cervical glands were palpable. The liver was found to extend to below the level of the umbilicus and 2 cm. to the left of the midline at the umbilicus. The spleen was palpable several centimeters below the costal margin. There was no fluid in the abdomen. The evening temperature during hospitalization varied from 99.8° to 102.8° F.

Technical Findings. The Wassermann test was negative on two occasions and that of the mother also. Roentgenologic examination of the lungs and gastrointestinal tract was negative. The urine showed a trace of albumin. The hemoglobin was 55 per cent, the red cell count 3,360,000. The white cell count varied from 5600 to 6200 with 67 per cent neutrophils and 28 per cent lymphocytes. The Widal test was negative for the typhoid group of organisms. The urine and blood culture showed an organism morphologically and culturally identical with Brucella melitensis. The patient's serum, unfortunately, could not be tested for agglutinins because she left the hospital at this time.

Comment. Brucella melitensis infection is characterized by waves of fever alternating with afebrile periods—a fever with the peak in the evening, and morning remissions. Chills, sweats, anorexia, and loss of weight accompany the fever in almost all cases. Arthritic pains, and even swelling of the joints may be prominent in the picture. Most of these symptoms were present in the above cases. The liver and spleen may be enlarged. Miss Evans[8] has shown the relationship between Brucella melitensis of goats and Brucella abortus, the latter occurring chiefly in cattle, and also in hogs.

It has been the impression of several writers that the strain occurring in the goat will produce in the human a more serious course of the disease than the bovine strain. In this small group of contrasting cases, this seems to be borne out. The last 3 of the above cases, infection by goat milk, have shown an undulant type of fever, in 2 cases over a long period of time. There have been arthritic symptoms, splenic and hepatic enlargement, and more severe systemic manifestations than in the 3 cases of bovine origin. Case VI presents a typical clinical picture of severe Malta fever, with the isolation of the organism by blood and urine culture, although the agglutination test could unfortunately not be made. It is interesting to note that the white count was in all cases within normal limits and that lymphocytes may be the predominating cells.

It is evident that Brucella melitensis infection is becoming more commonly recognized, but without question it is often considered to be typhoid fever. It is interesting that this diagnosis was made by the original attending physician in each of the 3 cases in Utah, in a portion of the country where typhoid fever is endemic.

The diagnosis in undulant fever is confirmed by obtaining the organism by blood culture, and by agglutination tests. It is the general consensus of opinion that agglutination in a dilution of 1 to 50 or higher is evidence of Brucella melitensis infection.

Summary and Conclusions. 1. An increasing number of case reports in the literature shows the more frequent recognition of Brucella melitensis infection.

2. Six further contrasting cases are reported. Three of these originated in Michigan, infection no doubt from the bovine source; the remaining 3 were in Utah, with goat milk as the presumable source of infection.

3. It seems probable that the infection resulting from the goat strain of the organism is more likely to produce a more serious clinical course.

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THE PERCUSSION OF THE HEART BORDERS AND THE ROENTGEN RAY SHADOW OF THE HEART.

A Study of One Hundred Cases.

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Introduction. The value of attempting to percuss the heart borders for the purpose of determining size and shape has long been disputed, and at the present time there is a very definite divergence of opinion on the question.

Cabot[1] states: "The longer I have tried to percuss the heart area, and the more I have watched others attempt to do so, correlating the results with postmortem records and Roentgen findings, the less I believe in the value of cardiac percussion. I rarely attempt it." Several years ago Shattuck[2] wrote: "It is not worth while to attempt by any ordinary percussion methods to make a silhouette

outline of the heart. It is better to note the relations of dullness in terms of interspaces and anatomic lines and to compare the findings with a subjective standard based on experience, than to judge of enlargement by measurements or ordinary percussion outlines and comparison of them with orthodiagraphic standards." Wilson and Merrill[3] are less pessimistic as to the usefulness of percussion for they express the opinion that "Inaccurate though they be, inspection, palpation and percussion are very useful in judging the heart's size, but they do not compete in accuracy with the Roentgen ray."

Vaquez,[4] on the other hand, supports the view that percussion of the heart borders may be accomplished with a considerable degree of accuracy and gives several pages of his book to the discussion of this subject. He writes: "The object of percussion is to outline the heart's dullness which corresponds to the projection of the heart on the chest wall. Less exact, perhaps, than the roentgenoscopic examination or, rather, less explicit, it has the compensating advantage of not requiring the aid of any apparatus and of being available at any time, even at the bedside of the patient." According to Dietlen,[5] "It is possible by comparison with the Roentgen ray diagram so to control one's own percussion technique as to enable one to outline the entire heart on the chest wall." Moritz is also an advocate of this idea and presents instances in which the projection on the chest wall as determined by percussion coincides almost exactly with the orthodiagraphic silhouette.

The present paper is an endeavor to determine the trustworthiness of the percussion of the heart borders as compared with the "7-foot Roentgen ray plate." The study is based upon the examination of 100 patients of all ages and both sexes, seen in the Outpatient Department and wards of the Massachusetts General Hospital. The actual percussion was carefully done by three well-trained observers and the Roentgen ray plates were measured and checked by a fourth. Although there are certain limitations and sources of error which will be discussed later, this procedure affords a fairly satisfactory means of judging the usefulness of our ordinary percussion methods in determining both the size and shape of the heart.

Technique. *Percussion.* This was carried out with the patient sitting erect, whenever possible, either in a chair (70 cases), as in the Outpatient Department, or in bed (22 cases), as in the case of ward patients. Eight cases only were examined in the recumbent or semirecumbent position. Physical examination in the erect sitting position in a chair undoubtedly is better for comparison of percussion and Roentgen ray findings than is the erect sitting or recumbent position in bed because the "7-foot" Roentgen ray plate is ordinarily taken with the patient upright. We have encountered individuals in whom the sitting position in bed displaced the heart outward and upward to a very appreciable degree by the pressure of the diaphragm in this awkward posture.

A moderately heavy percussion stroke was used to determine the right border and a somewhat lighter stroke the left. As one approaches the edge of the heart there is a gradual change in note and if the line marking the first slight change is taken as the heart border it will be found to lie considerably outside the actual Roentgen ray shadow. In this study percussion was carried to the first definite point of dullness, corresponding more to what was formerly described as the "absolute dullness of the heart" than to the "relative dullness." We have paid little attention, however, to the areas of so-called "relative" and "absolute" dullness as they have been more often confusing than helpful; our percussion borders have fallen between the two and have proved more accurate and useful than the older marks. In percussion the sensation of resistance under the finger is probably as important as the change in note to the ear. Naturally experience aids greatly in the appreciation of these changes.

A few cases must prove exceptions to the usefulness of percussion of the heart on physical examination. Now and then extreme obesity or well-marked pulmonary emphysema or distention of the stomach or intestines with air prevents obtaining any satisfactory percussion outlines whatsoever (or even palpable apex impulses). These cases require Roentgen ray study. They have necessarily been omitted from the present study.

In each of our cases the following measurements were made from the midsternal line: (1) The point of the maximal apex impulse; (2) the left border of dullness in the second, third and fifth interspaces routinely and in the fourth or sixth if indicated; (3) the right border of dullness in the second and fourth spaces; (4) the midclavicular line; (5) the nipple lines, right and left.

To obtain the so-called midclavicular line the distance from the middle of the suprasternal notch to a perpendicular line dropped from the lateral end of the clavicle was measured, and half this distance was assumed to mark the position of the midclavicular line.

Roentgen Ray. Each Roentgen ray plate by which the measurements were checked was taken with the patient erect in a chair with his back to the Roentgen ray tube and the front of his chest in contact with the plate holder which was 7 feet from the source of the rays. The point focused upon was at about the level of the fifth or sixth thoracic vertebra. At this distance distortion due to the divergence of the rays amounts to not more than 0.5 to 1 cm. in the maximum dimensions. P. C. Hodges,[6] in comparing the orthodiagram with the teleoroentgenogram taken at 7 feet, has shown that the cardiac area is practically always greater in the 7-foot plate than in the orthodiagram, but the difference is less than 10 per cent. For determining the difference in any linear dimension he made his computations on the basis of similar triangles and considered the average distance between the heart and the Roent-

gen ray plate to be 8 cm. According to this reasoning, an actual dimension of 12 cm. would appear on the 7-foot plate as 12.45 cm., an error of 4.5 mm. A dimension of 6 cm. would be projected as 6.23 cm., an error of 2.3 mm. Conversely, a dimension of 12 cm. on the 7-foot plate theoretically represents 11.55 cm., an error of 4.5 mm., and 6 cm. on the 7-foot plate represents a line actually only 5.78 cm. long, or an error of 2.2 mm.

Results. In tabulating the data they were first grouped according to the three observers. The average errors for all three were found to be so similar that this personal factor could be ignored and a second tabulation was made, dividing all the patients into two main divisions, children (fifteen years and under) and adults (over fifteen years). Each of these two divisions was separated into groups of normal and abnormal hearts. A further subdivision was made on the basis of thickness of chest and position of the patient at the time of examination. By combining the figures for related groups and finally summarizing the results of all the groups, a composite summary of the entire 100 patients was made, and appears in the last line of Table III.

The distance from the midsternal line to the heart border as determined by percussion was measured to the nearest 0.5 cm., and in some cases where the borders seemed very definite a + or − was affixed to indicate that it was slightly more or less. Since it was desirable to have some definite figures by which to measure the error, the Roentgen ray dimensions were recorded in centimeters and millimeters and the error figured in the same units. Superficially this gives the impression that we were recording our data with an accuracy not warranted by the conditions, but in order to calculate average and maximum errors, exact figures of some kind were essential and were employed with a full appreciation of this apparent inconsistency. Calculations were made to include for each dimension: (1) The number of cases in which the percussed border fell outside the Roentgen ray border; (2) the number of cases in which the percussed border lay inside the Roentgen ray border; (3) the number of cases in which the percussion corresponded exactly with the Roentgen ray shadow; (4) the maximum error when the percussion border lay outside; (5) the maximum error when the percussion border fell inside; (6) the average error. The 7-foot plate, in itself, has certain limitations and difficulties which will be considered later, chief among these being rotation which occurred in about half the cases. Correction for this error was made so far as possible in the calculations.

Comparing the results in the larger groups and divisions, it will be seen that age is a minor factor, for there was very little difference in the average error made in children and that made in adults. As concerns the patients with thin and those with thick chest walls, although it is apparently more difficult to percuss the heart border

of an obese individual, the final results of this study show the average error in the two groups to be remarkably similar and, indeed, the greatest errors were sometimes made in patients with thin chests.

In Table I are contained the measurements taken on 5 patients, picked at random, representing the tabulation of the original data from which the calculations were made.

A study of Table II brings out the following points with respect to the various measurements taken:

1. *Apex and left border of dullness:* In 57 per cent of the cases in which this correlation was noted the apex impulse corresponded almost exactly to the left border of dullness. When there was any discrepancy the apex was more often inside the left border of dullness than outside, the maximum difference being 2 cm. and the average 0.2 cm.

2. *Apex impulse and ML:* The apex impulse was found to be maximum at a point slightly inside the left border of the cardiac Roentgen ray shadow in 57 cases, outside in 25 cases and corresponded exactly in 7. In 11 cases it was not recorded. The maximum variation was 2 cm. and the average 0.6 cm.

Table III contains the bulk of the data relating to the differences between the percussion and the Roentgen ray findings. The various groups are considered separately and appropriate totals calculated to give a summary of the related groups and the entire series. Each dimension is considered separately and the results tabulated under six headings. The letters L and R designate left and right interspaces respectively, and the subscripts refer to the number of interspace, that is, L_5 means the dimension as measured in the fifth left interspace. The column marked "outside" gives the number of cases in which the percussion border lay outside the Roentgen ray border. The column marked "inside," similarly, gives the number of cases in which the percussion border lay within the Roentgen ray border. In a few cases the two coincided and these are listed in the column marked "exact." The maximum errors in the various groups of cases were noted and these are listed in the columns marked "maximum distance outside" and "maximum distance inside," depending upon whether the percussion border lay outside or inside the Roentgen ray border. The column marked "average error" contains the arithmetical average of the error irrespective of whether they were inside or outside. It will be noticed that the totals for all the various dimensions in any one group are not exactly the same, due to the fact that in a few cases certain dimensions had for some reason not been taken.

An analysis of Table III discloses the following:

1. *Left border of dullness in the fifth space (or in the fourth or sixth space):* The average difference (or "error") varied from 0.2 to 1.5 cm. but for most of the group and for the entire series, remained remarkably constant at 0.6 cm. In all groups the percussion border was more apt to fall outside the Roentgen ray border than inside, and of the whole series 53 fell outside, 40 inside and 7 coincided exactly. The maximum error made in children

TABLE I.—PERCUSSION AND ROENTGENOLOGIC MEASUREMENTS ON FIVE PATIENTS PICKED AT RANDOM.

Name.	Age in years.	Type chest.	Position.	L_2P.	L_2X.	Error L_2.	Apex.	Apex −LBD.	L_3P.	L_3X.	Error L_3.	L_4P.	L_4X.	Error L_4.	R_2P.	R_2X.	Error R_2.	R_4P.	R_4X	Error R_4	MCL	R. Nip.	L Nip.	Tr.	Ch/2.	Enlargement. MCL.	Enlargement. C/Th.	Diagnosis.
A. S.	9	Med.	Erect	6.5	6.0	+0.5	6.5	0	4.0	4.5	−0.5	2.0	3.5	−1.5	2.5	2.5	0	3.5	3.7	−0.2	6.8	8.0	8.0	9.6	10.6	−0.8	−1.0	RHD;MR;MS;AR
E. G.	11	Obese	Erect	7.0+	7.9	−0.9	7.0	−0.2	4.5	5.1	−0.6	3.0	3.6	−0.6	2.0	2.5	−0.5	3.5	3.8	−0.3	6.0+	9.0	8.5	12.1	11.2	+2.2	+0.9	RHD;MR;MS.
R. W.	58	Thin	Erect	8.0−	8.7	−0.7	8.0+	+0.4	3.5	4.5	−1.0	2.0+	3.0	−1.0	2.0−	2.2	−0.2	3.0	3.6	−0.6	7.5	10.0	10.0+	12.3	12.5	+1.2	−0.2	Angina pectoris.
R. P.	9	Thin	Recumbent	7.0	7.8	−0.8	7.0	0	4.0	5.5	−1.5	2.0	3.8	−1.8	2.0	2.7	−0.7	3.0	3.1	−0.1	5.5	6.5	6.3	11.1	9.5	+2.3	+1.6	RHD;MS;MR.
E. G.	53	Med.	Erect	8.0	7.0	+1.0	8.0	0	4.5	4.6	−0.1	2.5	4.0	−1.5	2.0	2.3	−0.3	3.5	4.2	−0.7	8.5	9.5	9.0	12.3	12.5	−0.7	−0.2	Normal heart.

L, left; R, right; numbers represent interspaces; P, percussion measurement; *X*, roentgen ray measurement; LBD, left border dullness; +, outside of roentgen ray shadow; −, inside of Roentgen shadow; RHD, rheumatic heart disease; MR, mitral regurgitation; MS, mitral stenosis; AR, aortic regurgitation. Measurements are all in centimeters and fractions of centimeters.

TABLE II.—SHOWING RELATION OF APEX IMPULSE TO LEFT BORDER OF DULLNESS AND TO LEFT BORDER OF CARDIAC SHADOW (ML) BY ROENTGEN RAY.

	Relation of apex impulse to LBD.						Relation of apex impulse to ML.					
	Number outside LBD.	Number inside LBD.	Number the same.	Maximum distance outside.	Maximum distance inside.	Average difference.	Number outside ML.	Number inside ML.	Number the same.	Maximum distance outside.	Maximum distance inside.	Average difference.
Children with normal hearts:												
Thin or medium chests	3	0	4	+0.5	0	0.2	0	6	1	0	−0.5	0.6
Obese	0	0	2	0	0	0	1	1	0	+0.5	−0.5	0.5
Total children with normal hearts	3	0	6	+0.5	0	0.1	1	7	1	+0.5	−0.5	0.6
Children with abnormal hearts:												
Thin or medium chests	4	11	26	+0.5	−2.0	0.2	12	27	2	+1.0	−1.5	0.6
Obese	0	1	3	0	−0.2	0.1	1	3	0	+0.2	−1.2	0.7
Total children with abnormal hearts	4	12	29	+0.5	−2.0	0.2	13	30	2	+1.0	−1.5	0.6
Total children	7	12	35	+0.5	−2.0	0.2	14	37	3	+1.0	−1.5	0.6
Adults with normal hearts:												
Thin or medium chests only	1	0	2	+0.5	0	0.2	1	2	0	+0.2	−1.0	0.7
Adults with abnormal hearts:												
Thin or medium chests	4	10	12	+0.7	−1.0	0.3	9	14	3	+1.2	−2.0	0.6
Obese	4	0	1	+1.0	0	0.5	1	4	1	+0.4	−1.2	0.7
Total adults with abnormal hearts	8	10	13	+1.0	−1.0	0.4	10	18	4	+1.2	−2.0	0.6
Total adults	9	10	15	+1.0	−1.0	0.3	11	20	4	+1.2	−2.0	0.6
Total children and adults	16	22	50	+1.0	−2.0	0.2	25	57	7	+1.2	−2.0	0.6

Measurements in centimeters; +, outside of cardiac shadow; −, inside of shadow.

TABLE III.—CORRELATION OF PERCUSSION AND ROENTGEN RAY FINDINGS.

Measurements in centimeters; +, outside of cardiac shadow; −, inside of shadow.

TABLE III.—CORRELATION OF PERCUSSION AND ROENTGEN RAY FINDINGS.

	L_1.						L_2.						L_3.						R_2.						$L_2 + R_2$.						R_4.					
	Outside.	Inside.	Exact.	Max. dist. outside.	Max. dist. inside.	Av. error.	Outside.	Inside.	Exact.	Max. dist. outside.	Max. dist. inside.	Av. error.	Outside.	Inside.	Exact.	Max. dist. outside.	Max. dist. inside.	Av. error.	Outside.	Inside.	Exact.	Max. dist. outside.	Max. dist. inside.	Av. error.	Outside.	Inside.	Exact.	Max. dist. outside.	Max. dist. inside.	Av. error.	Outside.	Inside.	Exact.	Max. dist. outside.	Max. dist. inside.	Av. error.
Children with normal hearts and thin or medium chests:																																				
Erect in chair	1	5	0	+0.5	−1.5	0.8	0	6	0	0	−2.5	1.4	0	3	0	0	−1.9	1.3	1	1	0	+0.5	−0.5	0.5	0	5	0	0	−3.1	1.8	3	2	1	+2.5	−1.3	0.8
Erect in bed	1	1	1	+0.4	−0.5	0.3	0	3	0	0	−2.5	2.1	0	3	0	0	−2.4	1.9	1	1	1	+0.4	−1.1	0.5	0	3	0	0	−3.5	2.2	1	1	1	+1.0	−0.2	0.4
Total children, normal, thin	2	6	1	+0.5	−1.5	0.6	0	9	0	0	−2.5	1.7	0	6	0	0	−2.4	1.6	2	2	1	+0.5	−1.1	0.5	0	8	0	0	−3.5	1.9	4	3	2	+2.5	−1.3	3.7
Children with normal hearts and thick chest wall:																																				
Erect in chair	1	0	0	+0.6	0	0.6	0	1	0	0	−1.1	1.1	0	1	0	0	−1.8	1.8	0	1	0	0	−0.6	0.6	0	1	0	0	−2.4	2.4	0	1	0	0	−0.3	0.3
Recumbent or semirecumbent	0	1	0	0	−0.4	0.4	0	1	0	0	−0.6	0.6	1	0	0	+0.2	0	0.2	0	1	0	0	−0.6	0.6	0	1	0	0	−0.4	0.4	0	1	0	0	−0.3	0.3
Total children, normal, obese	1	1	0	+0.6	−0.4	0.5	0	2	0	0	−1.1	0.9	1	1	0	+0.2	−1.8	1.0	0	2	0	0	−0.6	0.6	0	2	0	0	−2.4	1.4	0	2	0	0	−0.3	0.3
Total children, normal hearts	3	7	1	+0.6	−1.5	0.6	0	11	0	0	−2.5	1.5	1	7	0	+0.2	−2.4	1.2	2	4	1	+0.5	−1.1	0.5	0	10	0	0	−3.5	1.9	4	5	2	+2.5	−1.3	0.6
Children with abnormal hearts and thin or medium chests:																																				
Erect in chair	19	20	0	+1.3	−1.2	0.6	5	31	3	+1.0	−2.8	1.2	0	33	3	0	−2.3	1.2	6	27	3	+0.8	−2.0	0.5	3	34	1	+1.2	−3.3	1.6	6	31	1	+1.0	−1.9	0.7
Erect in bed	1	1	0	+0.4	−0.8	0.6	0	2	0	0	−3.0	1.8	0	2	0	0	−1.9	1.3	0	1	1	0	−0.2	0.1	0	2	0	0	−1.9	1.4	1	1	0	+0.1	−0.6	0.4
Recumbent or semirecumbent	0	2	0	0	−0.8	0.5	0	2	0	0	−3.2	2.4	0	2	0	0	−2.7	2.3	1	1	0	+0.3	−0.7	0.5	0	2	0	0	−2.5	2.5	1	1	0	+0.8	−0.1	0.5
Total abnormal hearts, thin	20	23	0	+1.3	−1.2	0.6	5	35	3	+1.0	−3.2	1.9	0	37	3	0	−2.7	1.3	7	29	4	+0.8	−2.0	0.5	3	38	1	+1.2	−3.3	1.7	8	33	1	+1.0	−1.9	0.7
Children with abnormal hearts and thick chest wall:																																				
Erect in chair	0	3	0	0	−1.0	0.8	0	3	0	0	−1.2	0.6	0	3	0	0	−1.4	0.8	0	3	0	0	−2.4	1.1	0	3	0	0	−3.8	1.9	0	3	0	0	−2.4	1.1
Erect in bed	1	0	0	+0.2	0	0.2	0	1	0	0	−1.4	1.4	0	1	0	0	−2.5	2.5	0	1	0	0	−0.2	0.2	0	1	0	0	−2.7	2.7	0	1	0	0	−0.2	0.2
Total, abnormal hearts, obese	1	3	0	+0.2	−1.0	0.6	0	4	0	0	−1.4	0.8	0	4	0	0	−2.5	1.2	0	4	0	0	−2.4	0.9	0	4	0	0	−3.8	2.1	0	4	0	0	−2.4	0.9
Total children, abnormal hearts	21	26	0	+1.3	−1.2	0.6	5	39	3	+1.0	−3.2	1.2	0	41	3	0	−2.7	1.3	7	33	4	+0.8	−2.4	0.5	3	42	1	+1.2	−3.8	1.7	8	37	1	+1.0	−2.4	0.8
Total children	24	33	1	+1.3	−1.5	0.6	5	50	3	+1.0	−3.2	1.3	1	48	3	+0.2	−2.7	1.3	9	37	5	+0.8	−2.4	0.5	3	52	1	+1.2	−3.8	1.7	12	42	3	+2.5	−2.4	0.7
Adults with normal hearts and thin or medium chests:																																				
Erect in chair	0	2	0	0	−1.5	1.5	0	2	0	0	−1.2	1.2	0	1	0	0	−1.8	1.8	1	0	0	+0.2	0	0.2	0	2	0	0	−1.6	1.4	1	1	0	+0.5	−0.5	0.5
Erect in bed	1	0	0	+1.0	0	1.0	0	1	0	0	−1.2	1.2	0	1	0	0	−1.5	1.5	0	1	0	0	−0.3	0.3	0	1	0	0	−1.8	1.8	0	1	0	0	−0.7	0.7
Recumbent or semirecumbent	0	1	0	0	−0.4	0.4	0	1	0	0	−2.0	2.0	Not measured.																		0	1	0	0	−0.1	0.1
Total adults, normal hearts, thin	1	3	0	+1.0	−1.5	1.1	0	4	0	0	−2.0	1.1	0	2	0	0	−1.8	1.7	1	1	0	+0.2	−0.3	0.3	0	3	0	0	−1.8	1.5	1	3	0	+0.5	−0.7	0.5
Adults with abnormal hearts and thin or medium chest walls:																																				
Erect in chair	7	4	3	+2.1	−1.3	0.6	4	10	0	+0.6	−3.4	1.0	1	12	0	+0.3	−3.4	1.3	7	4	2	+1.6	−2.3	0.7	3	10	1	+0.6	−5.7	1.3	4	10	0	+1.1	−1.7	0.9
Erect in bed	4	6	2	+1.5	−1.1	0.6	3	8	1	+1.1	−3.4	1.3	0	10	1	0	−2.4	1.4	1	9	1	+0.5	−0.9	0.4	0	12	0	0	−3.3	1.7	3	9	0	+0.4	−1.9	0.9
Recumbent or semirecumbent	0	2	1	0	−1.0	0.5	0	3	0	0	−1.1	0.9	0	3	0	0	−2.2	1.4	0	3	0	0	−2.2	1.0	0	3	0	0	−3.2	2.5	0	3	0	0	−2.0	1.4
Total adults, abnormal, thin	11	12	6	+2.1	−1.3	0.6	7	21	1	+1.1	−3.4	1.1	1	25	1	+0.3	−3.4	1.4	8	16	3	+1.6	−2.3	0.6	3	25	1	+0.6	−5.7	1.5	7	22	0	+1.1	−2.0	1.0
Adults with abnormal hearts and thick chest walls:																																				
Erect in chair	3	1	0	+1.6	−0.4	1.0	1	3	0	+0.2	−1.1	0.6	1	1	0	+0.1	−0.9	0.5	1	1	0	+0.2	−0.3	0.3	0	4	0	0	−2.1	0.8	0	3	1	0	−4.4	1.7
Erect in bed	0	4	0	0	−1.7	1.5	0	4	0	0	−1.5	1.0	1	3	0	+0.5	−2.7	1.0	1	1	2	+0.4	−1.4	0.5	1	3	0	+0.5	−2.3	1.4	1	2	1	+0.4	−1.3	0.6
Recumbent or semirecumbent	1	0	0	+0.4	0	0.4	1	0	0	+0.5	0	0.5	1	0	0	+1.2	0	1.2	0	1	0	0	−1.5	1.5	0	1	0	0	−0.3	0.3	0	1	0	0	−2.3	2.3
Total adults, abnormal, obese	4	5	0	+1.6	−1.7	1.1	2	7	0	+0.5	−1.5	0.7	3	4	0	+1.2	−2.7	0.9	2	3	2	+0.4	−1.5	0.5	1	8	0	+0.5	−2.3	1.0	1	6	2	+0.4	−4.4	1.3
Total adults with abnormal hearts	15	17	6	+2.1	−1.7	0.7	9	28	1	+1.1	−3.4	1.0	4	29	1	+1.2	−3.4	1.3	10	19	5	+1.6	−2.3	0.6	4	33	1	+0.6	−5.7	1.4	8	28	2	+0.4	−4.4	1.1
Total adults	16	20	6	+2.1	−1.7	0.7	9	32	1	+1.1	−3.4	1.0	4	31	1	+1.2	−3.4	1.3	11	20	5	+1.6	−2.3	0.6	4	36	1	+0.6	−5.7	1.4	9	31	2	+1.1	−4.4	1.0
Total adults and children	40	53	7	+2.1	−1.7	0.6	14	82	4	+1.1	−3.4	1.2	5	79	4	+1.2	−3.4	1.3	20	57	10	+1.6	−2.4	0.5	7	88	2	+1.2	−5.7	1.6	21	73	5	+2.5	−4.4	0.8

Error calculated in centimeters; L_1 interspace on left; R_1 interspace on right; subscript indicates number of interspace.
Numbers in columns marked "outside," "inside" and "exact" stand for number of cases in which percussion border lay outside, inside or exactly on Roentgen ray border.

was 1.3 cm. to the outside in a child with a thin chest wall and an abnormal heart, and 1.5 cm. to the inside in a child with a thin chest and a normal heart. Among the adults the maximum error outside was 2.1 cm. made in a patient with a medium thick chest wall, an abnormal heart and sitting erect in a chair. The maximum error to the inside amounted to 1.7 cm. in an adult with a thick chest wall, an abnormal heart and sitting erect in bed.

2. *Left border of dullness in the third space:* In the large majority of the patients of all groups, the percussion border fell within the Roentgen ray border; of the entire series 82 fell inside, 14 outside and 4 coincided. The average error in children with thin chest walls and normal hearts was 1.7 cm., in children with normal hearts and thick chest wall 0.9 cm., in children with abnormal hearts and thin chest walls 1.9 cm. and in a small series of children with abnormal hearts and thick chest walls 0.8 cm. The average for 58 children of all types was 1.3 cm. For all the adult groups the error was very close to 1 cm. There was no constant relation between the amount of error and the position of the patient at the time of examination.

This dimension was found to be somewhat increased in most cases of mitral stenosis.

3. *Left border of dullness in second space:* The average error for 52 children was 1.3 cm., there being little variation from this figure in the groups classed as thin or obese, normal or abnormal. The average error in the largest group of adults, those with thin or medium chests and abnormal hearts, was 1.4 cm., and for all of the adults 1.3 cm. Of the 88 patients in which this measurement was noted, in 79 cases, or 90 per cent, the percussion border fell inside the Roentgen ray border, in 5, or 5.5 per cent it fell outside, and in 4, or 4.5 per cent, it coincided exactly. The maximum error to the inside was 3.4 cm. in the case of an adult with a medium thickness of chest wall, and an abnormal heart, sitting erect in a chair. The maximum error to the outside was made in an obese adult with an abnormal heart, lying recumbent in bed.

4. *Right border of dullness in second space:* The percussion of this dimension was apparently subject to less error than any of the others. In 13 cases this determination was not made, but of the remaining 87, 10, or 12 per cent, coincided exactly with the Roentgen ray border, 20, or 23 per cent, fell outside, and 57, or 65 per cent, inside. The average error for the series was 0.5 cm. and did not vary greatly from this figure for any of the smaller groups except in a group of 3 obese children with abnormal hearts, sitting erect in a chair, for which the average was 1.1 cm. The maximum error to the inside amounted to 1.6 cm. in an adult with a medium thickness of chest wall and an abnormal heart, sitting erect in a chair. The greatest error to the outside was made in an obese child with an abnormal heart, sitting erect in a chair.

5. *Supracardiac dullness in second space:* Considering the right and left second interspace dullnesses together as indicative of the width of the great vessels, in 88 of 97 cases the percussed dullness was narrower than the width as shown by Roentgen ray. In 7 cases it was wider and in 2 cases it was the same. The average error in children was 1.7 cm., in adults 1.4 cm., and for the whole series 1.6 cm. The maximum error 5.7 cm. was made in an adult with a medium thickness of chest wall and marked aortitis. This is the most difficult measurement to obtain with any degree of accuracy by percussion and is the least reliable except when abnormally wide, and even then the error may be great.

6. *Right border of dullness in fourth space:* In 5 cases there was exact agreement between the Roentgen ray and the percussion. In 73 cases the percussion border fell inside the Roentgen ray shadow and in 21 cases outside. The average error in the children was 0.7 cm., and in the adults

1 cm. The combined average error for the children and adults was 0.8 cm. The error was apparently greater in adults with thick chest walls than in those with thin or medium chests, but this did not seem to be a factor in the children. Position made no significant change. The maximum error of 4.4 cm. occurred in an obese adult with a heart which was greatly enlarged to the right but the enlargement was not detected by percussion. This was rather the exception, however, for the right border was ordinarily more accurately percussed in those cases which showed definite enlargement to the right.

7. *Nipple line:* The distance from the midsternal line to the left nipple line is very variable and bears no constant relation to the size of the chest. In only 8 cases did it correspond to the midclavicular line and in the large majority it fell from 0.5 to 5 cm. outside, the average difference being 1.2 cm. The distances of the right and left nipple lines from the midsternal line frequently differed by 1 cm. or more. The midclavicular line bears a fairly constant relation to the size of the chest and is, therefore, a far more reliable basis for the determination of cardiac enlargement.

8. *Heart Enlargement:* In this study a heart was considered to be enlarged if the left border of dullness at the apex fell outside the midclavicular line.* In judging enlargement by Roentgen ray, the cardiothoracic ratio was used and the heart was considered enlarged if the total transverse diameter of the heart exceeded one-half the maximum internal diameter of the chest.* The presence or absence of enlargement was determined by both methods in every case and the results listed in Table IV. There was complete agreement in 79 per cent and there were 21 more or less borderline cases of which 11 were slightly enlarged to percussion but not to Roentgen ray and 10 cases in which the reverse was true. Neither method is entirely satisfactory as a method of separating the abnormal from the normal heart as indicated by the fact that in 12 patients with definitely abnormal hearts there was no enlargement either by percussion or by Roentgen ray. On the other hand, there was only one normal heart which showed enlargement.

Comment. *Relation of Apex Impulse to Left Border of Cardiac Shadow.* It has already been noted that the apex impulse was frequently found to lie inside the left border of the heart. Dietlen found that the apex impulse corresponded with the left border in one-third of his cases and lay within in the other two-thirds. He explains this by the fact that the cardiac impulse occurs during systole when the heart is contracted, whereas the left border as determined either by percussion or orthodiagraph represents the heart in diastole with the muscle relaxed. Moreover, it is obvious that the point of maximum apex impulse, which is the basis for measurement, necessarily lies a little inside the outermost edge of the apex which is a rounded blunt structure. It should be added that sometimes the apex of the heart shadow in the 7-foot plate is so buried in the shadow of diaphragm and abdomen that the identification is largely guess work and less accurate than the position of the apex impulse as determined by palpation on physical examination. Of course, here orthodiagraphy has a decided advantage over tele-

* This is not strictly true, since normal exceptions occur, as for example, when a normal but transversely or horizontally placed heart exceeds these limits; such exceptions are not, however, common.

roentgenography in yielding clearer evidence of the position of the cardiac apex.

TABLE IV.—COMPARISON OF PERCUSSION AND ROENTGEN RAY METHODS OF DETERMINING ENLARGEMENT OF HEART.

	+ Percussion + Roentgen ray	− Percussion − Roentgen ray	Percussion and Roentgen ray agree.	− Percussion + Roentgen ray	+ Percussion − Roentgen ray
Children with normal hearts and thin or medium chests:					
Erect in chair	1	3	4	0	2
Erect in bed	0	3	3	0	0
Total children, normal hearts, thin	1	6	7	0	2
Children with normal hearts and thick chest walls:					
Erect in chair	0	1	1	0	0
Recumbent or semirecumbent	0	1	1	0	0
Total children, normal hearts, obese	0	2	2	0	0
Total children with normal hearts	1	8	9	0	2
Children with abnormal hearts, thin or medium chest walls:					
Erect in chair	20	6	26	6	7
Erect in bed	0	1	1	1	0
Recumbent or semirecumbent	1	1	2	0	0
Total children, abnormal hearts, thin	21	8	29	7	7
Children with abnormal hearts and thick chest walls:					
Erect in chair	3	0	3	0	0
Erect in bed	1	0	1	0	0
Total children, abnormal hearts, obese	4	0	4	0	0
Total children with abnormal hearts	25	8	33	7	7
Total children	26	16	42	7	9
Adults with normal hearts and thin or medium chest walls:					
Erect in chair	0	0	0	1	1
Erect in bed	0	1	1	0	0
Recumbent or semirecumbent	0	1	1	0	0
Total adults, normal hearts, thin	0	2	2	1	1
Adults with abnormal hearts and thin or medium chest walls					
Erect in chair	12	2	14	0	0
Erect in bed	9	1	10	2	0
Recumbent or semirecumbent	2	1	3	0	0
Total adults, abnormal hearts, thin	23	4	27	2	0
Adults with abnormal hearts and thick chest walls:					
Erect in chair	4	0	4	0	0
Erect in bed	3	0	3	1	0
Recumbent or semirecumbent	1	0	1	0	0
Total adults, abnormal hearts, obese	8	0	8	1	0
Total adults with abnormal hearts	31	4	35	3	0
Total adults	31	6	37	4	1
Total adults and children	57	22	79	11	10

Percussion +, enlarged to percussion; Roentgen ray +, enlarged by cardiothoracic ratio determined from plate; −, not enlarged.
Column 3 is sum of columns 1 and 2.

Probably the most important single dimension to be determined by percussion is the distance of the left border of dullness at the apex from the midsternal line, and the fact that the heart at this point is very close to the anterior chest wall favors a rather accurate determination of this border. The left border of dullness in the third interspace ordinarily receives little attention, but it has been found distinctly helpful in many of our cases. The so-called "mitral-shaped" heart is enlarged to the left "in the region of the left auricle and pulmonary artery," and, although the left auricle lies deeply in the chest and consequently dullness is not reached until its actual border, as determined by the Roentgen ray shadow,

would be passed, nevertheless this increased width of dullness can usually be readily detected. This is very likely due in the main part to the fact that the enlarged right ventricle, particularly its infundibulum or conus arteriosus, makes up the bulk of the enlargement of the heart shadow in its left upper and middle border rather than does the left auricle; the right ventricle is near the anterior chest wall. It is difficult to lay down any set rule for calculating the actual enlargement in this region, as it must be judged in relation to the other dimensions, but arbitrarily one may say that if the left border in the third space is determined by percussion to be 5 cm. or more and by Roentgen ray to be 6 cm. or more from the midsternal line, this sign is suggestive of mitral stenosis, and, considered with the other findings, is an important aid in diagnosis. It has seemed also that abnormal prominence of the left upper border of the heart is present if the percussion dullness in the third interspace is more than half the distance of the midclavicular line or more than half the distance to the apex impulse or the left border of dullness in the fifth interspace.

Percussion in the second left interspace is decidedly unsatisfactory, due to the depth of the underlying structures, particularly the descending aorta which probably cannot be percussed at all on the anterior chest wall unless it is markedly enlarged; it is notoriously difficult generally to percuss even an aneurysm of the descending aorta. Marked increase in width of the great vessels gives a widened area of dullness, but the borders as determined by percussion are apt not to agree very closely with the Roentgen ray shadow except in the case of well-marked patency of the ductus arteriosus which frequently gives increased dullness to percussion and increased heart shadow by Roentgen ray in the second left interspace, sometimes even in the third left interspace.

Percussion in the second right interspace agrees remarkably well with the Roentgen ray findings, but as the arch of the aorta in this region is a considerable distance fom the anterior chest wall, the explanation must lie in some factor other than accurate percussion of the aortic arch. Probably the most logical explanation is the fact that the edges of the aorta and superior vena cava on the right lie almost directly under the right sternal border, and it may be in large part the sternum rather than the great vessels that is often responsible for the dullness to percussion.

The entire right border of the heart shadow in the majority of cases was found to lie about 1 cm. outside the percussion border. Due to the depth of this portion of the heart, heavy percussion is necessary to obtain any change in note, but marked enlargement to the right can ordinarily be detected by percussion even though the border of dullness does not represent exactly the cardiac outline. In many instances the right border can be more accurately percussed with the lungs in full expiration.

As previously mentioned, little attention was paid by us to the so-called "relative" and "absolute" cardiac dullness, but percussion was carried to the point which experience and frequent checking with the 7-foot plate had taught the observer was the degree of dullness produced by the underlying heart border. Dietlen[5] presents data and figures which prove that, with sufficient experience and skill, the entire outline of the heart can be projected on the chest wall by percussion, closely coinciding with the orthodiagraphic outline. He feels, as we do, that it is possible by comparison with the Roentgen ray diagram so to control one's own percussion technique that the latter may be relied upon to determine with a fair degree of accuracy the actual position of the heart borders.

Granting that the cardiac borders can be fairly accurately projected upon the anterior chest wall by the percussion method, there still remains the difficult problem of judging whether the heart in any given case is enlarged. Some of the workers who have extensively employed the orthodiascope have devised rather complicated methods for determining the degree of enlargement. Dietlen,[5] for example, considers several factors—the ratio of the total transverse diameter of the heart to the internal diameter of the thorax, the height, weight, age and sex of the patient. By comparing his findings with tables of accepted normal standards, he is able to judge with fair accuracy the degree of enlargement. Eyster,[7] with the use of a planimeter, actually measures the area of the anterior projection of the cardiac shadow as determined by the orthodiagraph and, taking into consideration the age, sex, height and weight of the patient, calculates the amount of enlargement. These procedures are valuable where as high a degree of accuracy as is possible is wanted. It is often desirable or necessary, however, when making a physical examination, to have some quick method by which the heart size can be judged without the use of expensive apparatus. It is in this connection that percussion of the heart border is most useful. For many years clinicians judged enlargement by the relation of the left cardiac border to the nipple line. The underlying principle, that the left heart border moves outward during dilatation or hypertrophy is undoubtedly correct, but judging the amount of outward motion by so variable a factor as the nipple line hardly seems justifiable. If, however, one uses the midclavicular line which bears a fairly constant relation to the size of the chest, then this method becomes of definite diagnostic value, and there is at the present time considerable evidence in favor of the statement that any heart, the apex or left border of which lies outside the midclavicular line, is probably enlarged. This is subject to certain modifications, for in little children and in persons with comparatively short chests the heart lies transversely, and allowances have to be made in such instances. This general principle was confirmed in the present study by the fact that practically all of the hearts,

which in every respect appeared normal, lay within the left midclavicular line, and 78 per cent of those which showed signs of pathology extended past the midclavicular line.* In a number of cases the apex fell outside the midclavicular line and inside the nipple line, which, according to our standards, was interpreted as enlargement, but would have been considered within the normal range by those who use the nipple line as the outer limit. The method of using calipers to determine the external diameter of the chest and employing this as a basis for calculating enlargement has been tried by us but found much less satisfactory than simply noting the relation of the apex to the midclavicular line.

Enlargement in the 7-foot plate was judged by the cardiothoracic ratio, namely, the ratio of the total transverse diameter of the heart to the maximal internal transverse diameter of the thorax. A heart was considered to be within normal limits if its transverse diameter was not over half the internal diameter of the chest.* A comparative study of the results of the two methods of judging heart enlargement, namely by the relation of the left border of dullness to the midclavicular line and by the cardiothoracic ratio, shows that the two practically parallel each other.

It is not however within the scope of this paper to go into any detailed discussion as to methods of determining cardiac enlargement. Eyster[7] has recently made a careful study of the various methods of separating the normal from the enlarged heart and has come to the conclusion that the method of predicting the orthodiagraphic area by a formula involving the height, weight and age gives the best separation, and that the cardiothoracic ratio is a comparatively crude method. He also feels that the midclavicular line is of distinct value and that 95 per cent of all normal hearts lie within this line.

The 7-foot plate is not without its drawbacks and certain difficulties were encountered. If the patient failed to sit erect, but leaned either forward or backward, the relations between cardiac silhouette and the interspaces were slightly altered. A number of plates were taken of the same individual sitting erect, leaning forward and leaning backward, and the actual error was found to amount to only a few millimeters in any given case. The chief difficulty came from rotation of the patient with respect to the plane of the Roentgen ray plate, and this occurred in about 50 per cent of the cases. It was readily detected on the film by the relation of the medial ends of the clavicles to the midline of the spine and sternum, and by measuring the amount of distortion, the

* It is to be remembered that there may be definite and even considerable increase in the distance from the midsternum, of the left heart border either by percussion or by Roentgen ray in the third left interspace, with mitral stenosis or congenital heart disease, even though the apex impulse and left border of the heart are within the midclavicular line in the fifth interspace. Such hearts should, of course, also be considered to be enlarged.

correction could be calculated and applied to the measurements. After the correction had been thus made the plates on which rotation occurred were apparently as accurate as those in which there was no rotation. A slight distortion results from the divergence of the rays as they strike the plate, but this amounts to only a few millimeters in the maximum dimensions; the thicker the chest wall, the greater this error is bound to be.

It is very important to remember that subjective errors may enter into Roentgen ray measurements. To the lay mind and even sometimes to the medical mind the Roentgen ray is infallible. So it is, if technique and interpretation are perfect. But both technique and interpretation are sometimes in error and the Roentgen ray of the heart provides no exception to this possibility. Rotation of the subject, too short a distance between Roentgen ray tube and subject, errors in measurement and errors in recording the measurements are all possible and must constantly be guarded against. It has been our experience that physical examination with careful percussion of the heart is a very valuable check on the Roentgen ray itself; sometimes it has occasioned a review or repetition of the Roentgen ray picture with correction of the original report.

Summary and Conclusions. 1. One hundred individuals with normal and abnormal hearts have been studied by percussion and Roentgen ray measurements of the borders of the heart and great vessels.

2. Percussion is of value for the following reasons: (*a*) It is reasonably accurate, as shown by comparison with the 7-foot Roentgen ray plate; (*b*) a Roentgen ray plate is often difficult or impossible to obtain; (*c*) it is simple, rapid and requires no apparatus; (*d*) it is a valuable check on the accuracy of Roentgen ray technique and interpretation.

3. The apex impulse is not always as accurate as the left border of dullness, but is often easier to determine on physical examination. It should always be checked against the left border of dullness in the fifth (or sixth) space and compared with the midclavicular line. Palpation of the apex impulse may sometimes give a more accurate evidence of the position of the cardiac apex than can be obtained from the 7-foot Roentgen ray film when the shadow of the apex is obscured in other shadows.

4. The nipple line is too variable to be of any value in determining enlargement. The midclavicular line is a much more reliable index.

5. Percussion should always be attempted in the third left interspace, as this may be the only portion of the heart which is enlarged to physical examination, as in mitral stenosis and congenital heart disease.

6. Percussion in the second interspace, both to left and right, and in the fourth right interspace should always be attempted, because in case of marked increase widening can usually be detected even though the measurements themselves are bound to be inexact.

NOTE.—We desire to thank the members of the Roentgen ray Department of the Massachusetts General Hospital, Dr. George H. Holmes director, for their cordial assistance, and also Drs. Howard B. Sprague and Seeley G. Mudd for their valuable aid in obtaining the percussion outlines in one-third of the cases.

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ANEURYSM OF THE SPLENIC ARTERY.

WITH REPORT OF A CASE WITH RUPTURE.

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ANEURYSM of the splenic artery is very unusual. Medical literature records less than 50 cases. I have been able to collect 45. The diagnosis before death has been made in only 1.

The etiology is obscure. Syphilis is not a cause. Arteriosclerosis undoubtedly accounts for some; on the other hand, 16 per cent of the 45 occurred in patients under thirty-five years of age. Sex is not a factor, and contrary to the general rule in aneurysms, age is not a factor, as cases have been reported as early as twenty and as late as sixty-seven years. Trauma is rarely an exciting factor. It is worthy of note that aneurysm of the splenic artery has complicated pregnancy on 3 or 4 of the 45 occasions. The location of the aneurysm in most instances has been in the main trunk of the splenic artery; very few occur in the branches.

The symptoms of aneurysm of the splenic artery are six in number—abdominal pain, gastrointestinal hemorrhage, splenic tumor, tumor of the epigastrium pulsating with murmurs, anemia, and a Roentgen ray picture, which rules out a tumor of the stomach. More than one-half of the cases have demonstrated either gastrointestinal or intraperitoneal hemorrhages. Pain is not constant and the presence of a tumor is rare.

Splenic aneurysm has occurred most frequently complicating endocarditis and hypertension. It does occur in luetic cases but not often.

The condition has been operated on four or five times but only once has the diagnosis been made before the operation. *Hoegler* diagnosed correctly, operated, and saved the patient. *Davis* diagnosed a tumor, operated, found and removed an aneurysm and saved the patient. *Smith* diagnosed an ectopic pregnancy, operated, found an aneurysm, but the patient died.

The duration of these aneurysms has varied from one to fourteen years.

The diagnosis of an aneurysm of the splenic artery is difficult because little is known about it and because patients suffering from it are usually in coma or shock.

Case Report. The case, which I now report, occurred in my neurological service at the City Hospital in New York. The patient, a man aged seventy years, was brought in comatose and was aroused with some difficulty. The respirations were Cheyne-Stokes. The heart was enlarged, intermittent and irregular. The blood pressure was 190 systolic and 130 diastolic. On the left side was a complete hemiplegia with the deep reflexes exaggerated, especially on the left side. The Babinski reflex was absent. The spinal fluid was under moderately increased pressure, the color clear. There were 17 cells but the globulin and Wassermann were both negative.

The diagnosis was general arteriosclerosis with cerebral hemorrhage. The patient remained in coma a few hours and died.

Autopsy (performed by Dr. J. R. Lisa) in abstract:

External Examination. The body is that of an adult male, well developed and well nourished. There are no external abnormalities. The skin is dry and lax. The muscles are atrophic in the left lower extremity.

Head. The dura is adherent to the skull cap. The basal vessels are sclerotic.

Thorax and Abdomen. The panniculus is well developed. The abdominal cavity is free of excess fluid. There is a hemorrhagic extravasation retroperitoneally extending in all directions from the region of the pancreas.

The lungs show marked engorgement but not areas of consolidation. The heart (500 gm.) is markedly hypertrophic on both its right and left sides. Section of the ventricular musculature shows areas of fibrosis. The valves are normal in appearance, with the exception of the aortic valve whose cusps are considerably thickened. The aorta is inelastic throughout its extent; and has many yellowish and calcareous plaques on its intimal surface. The coronary arteries are sclerosed but the luminæ are patent.

The parietal peritoneum is not injected. The omentum is short and thick and shows no fatty necrosis. *Pancreas* dissection shows the organ to be surrounded by recent antemortem blood clot which infiltrates its substance, compressing and displacing the greater part of the organ, as is seen on longitudinal section. Transverse section through the body of the pancreas just before its head, shows a circular dilatation of the splenic artery with lumen distended by laminated clot, evidently an aneurysm.

The *spleen* weighs 200 gm. The pulp scrapes easily. The Malpighian corpuscles are distinct; its fibrous markings are prominent.

The *duodenum and stomach* are not remarkable. The biliary passages are patent. The gall bladder is small and contracted.

The *liver* weighs 1600 gm. Its capsule is opaque; its surface is slightly irregular. Cut section shows diffuse yellowish mottling.

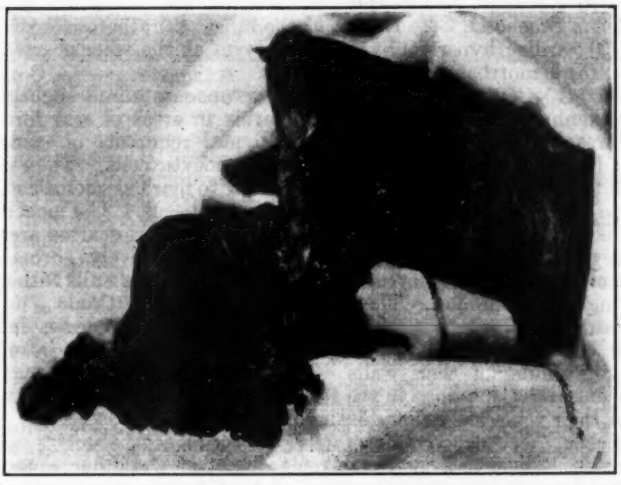

FIG. 1.—Longitudinal section through pancreas showing extensive peripancreatic hemorrhage and saccular aneurysm.

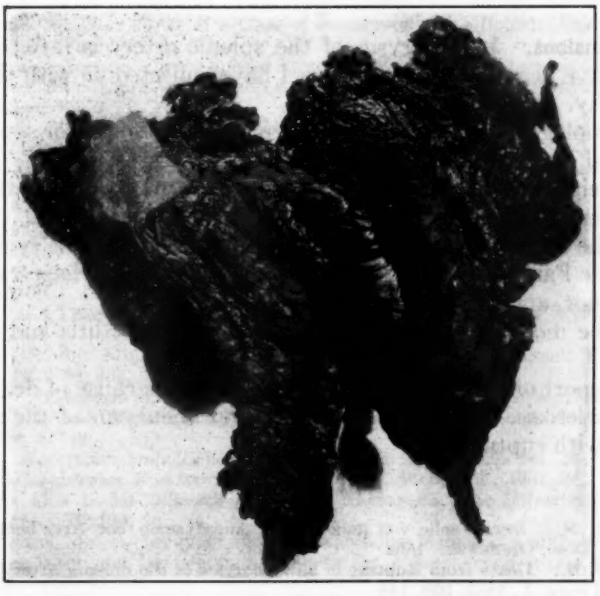

FIG. 2.—Transection of aneurysm showing thrombus and narrow lumen.

The *left kidney* weighs 150 gm. The capsule strips with ease, leaving a uniformally irregular surface with occasional depressions. The cortex and

medulla are normal in appearance. The vessels are prominent and thickened. The right kidney weighs 175 gm. and resembles its fellow on the left. The adrenals are not remarkable.

The *ureters, bladder, prostate* and *seminal vesicles* are normal in appearance.

Anatomic Diagnoses. (1) Edema of the lungs; (2) atherosclerosis of the aorta; (3) cardiac hypertrophy; (4) aneurysm of the splenic artery with rupture; (5) hemorrhage into the pancreas.

HISTOLOGY. *Kidney.* The capsule shows moderate and slightly irregular thickening with adherence to the cortex in areas of scar formation. These areas contain hyalinized glomeruli and remnants of compressed tubules, likewise a marked infiltration of lymphocytic cells. The glomeruli show all the changes from moderate thickening to marked sclerotic changes, complete atrophy and replacement by hyalinized tissue. The most marked change is the intense fibrosis. Scattered throughout are scarred areas with lymphocytic infiltration. The tubules are comparatively normal. The arteries in the cortex show intense sclerotic changes of the walls with marked narrowing of the lumina. The intima is smooth and thin. The tissue immediately adjacent to some of these thickened arterioles is intensely sclerotic and infiltrated. The large arteries show an intense intimal and medial thickening of their walls. The medulla is fairly normal. The arteries entering the kidney in the region of the pelvis likewise show thickening of their walls, medial and intimal.

Diagnosis. Vascular nephritis (arteriosclerotic).

Pancreas. There is a moderate replacement of glandular elements by infiltrated fat. Surrounding the organ and infiltrating it is a very marked hemorrhage with slight disintegration of the cellular elements.

Diagnoses. (1) Hemorrhage around and into the pancreas; (2) aneurysm of the splenic artery, with rupture.

Conclusions. 1. Aneurysm of the splenic artery is rare, only 50 cases have been reported of which I have collected 45 with the bibliography.

2. Etiology is obscure; arteriosclerosis may account for some, but rarely, if ever, syphilis.

3. Neither sex nor trauma are factors; age to a certain extent is, as 16 per cent occurred under thirty-five years.

4. The most common location is in the main trunk; the symptoms are six: Pain, splenic tumor, gastrointestinal hemorrhages, epigastric tumor, anemia, the Roentgen ray picture.

5. The most common complications are endocarditis and hypertension.

6. Report of a case with autopsy in which the cause of death was arteriosclerosis, cardiac hypertrophy, and aneurysm of the splenic artery with rupture.

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BLOOD CHANGES IN MALIGNANT DISEASE.

AN ANALYSIS OF 353 CASES.

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Clinically, the outstanding feature of the blood in cancer is an anemia more or less progressive with the advance of the disease. The cause of this anemia has not been definitely established. Undoubtedly there enter into its production several factors each of which plays a greater or smaller rôle in an individual case. Chronic, persistent hemorrhage has been assigned an important part in this regard.[1] That this is not, however, the only factor, even in ulcerating cases is suggested by the observation that anemia in patients with cancer of the rectum is, as a rule, not as marked as in patients with cancer of the stomach although hemorrhage is actually more frequent in the former disease.[2] The impaired nutrition associated with cancer of the stomach, related possibly, to some extent, to the accompanying achylia, is probably an active cause of the marked anemia usually accompanying that disease. Some writers[3, 4, 5] predicate the presence of a hemolytic toxin in the tumor tissue or its necrotic products. A clinical demonstration of hemolysis in cancer seems, however, to have been made only in very rare instances.[6] Some investigators[7, 8] have even categorically denied its occurrence. The so-called osteosclerotic type of anemia due to actual infiltration of the blood-forming organs with tumor tissue is occasionally found in cases of cancer associated with multiple skeletal metastases.[9] Anemia accompanying the leukemias is due to an analogous cause. It has been thought by some[10] that the anemia in cancer appears exaggerated due to a dilution of the blood by a lymphogogue action of toxins associated with cancer. Some[11] have regarded the anemia as the primary condition predisposing to the development of cancer rather than resulting from its occurrence. Aplasia of the bone marrow, aside from its occurrence secondary to chronic hemorrhage,[12] has not been demonstrated to have any specific relationship to the

malignant process.[13] The size of the tumor or the number or extent of dissemination of the metastases do not seem to have any definite relationship to the degree of the anemia.

Studies of the chemistry of the blood have been focused particularly upon the blood sugar. More than forty years ago there was described a hyperglycemia which was considered by some[15,16] as characteristic of the malignant disease and by others[17] merely as an accompaniment of the associated anemia. Of late, considerable impetus to the study of the blood sugar in cancer has been given by the recent interesting work on the sugar retention particularly in malignant disease of the gastrointestinal tract.

The purpose of this paper is to present an analysis of the routine blood examinations made in 353 cases of malignant disease of various types admitted to Montefiore Hospital during the period between January, 1921 and June, 1925.

Red Blood Cells. The average red blood cell count of the whole series was 3,569,000. This is very little lower than that obtained by Ewing[14] (3,700,000) in his series of 300 cases. The average red cell count and hemoglobin percentage in the various groups of malignant disease is shown in Table I.

TABLE I.—AVERAGE RED CELL COUNT AND HEMOGLOBIN PERCENTAGE IN VARIOUS GROUPS OF MALIGNANT DISEASE.

Disease.	No. of cases.	Red blood cells, per c.mm.	Hemoglobin, per cent.
Ca of oropharyngeal cavity	13	4,019,000	75
Ca of larynx, epiglottis, thyroid	11	4,013,000	74
Ca of lung (primary)	24	4,013,000	74
Ca of esophagus	11	3,947,000	61
Ca of rectum	39	3,887,000	67
Bone sarcoma	12	3,870,000	69
Ca of kidney, hypernephroma	12	3,730,000	64
Ca of ovary	13	3,678,000	69
Lymphosarcoma	17	3,595,000	62
Ca of colon	18	3,501,000	63
Hodgkin's disease	26	3,481,000	59
Ca of breast	52	3,378,000	64
Ca of biliary tract	14	3,236,000	58
Ca of stomach	76	3,198,000	52
Ca of uterus	15	3,175,000	59

When the average red cell count of the various types of malignant disease is graded according to million groups, it is noticed (Table II) that most of the groups, representing 74 per cent of all the cases, show an average red cell count of between 3 and 5 million, 23 per cent below 3 million and 3 per cent above 5 million.

The degree of anemia does not always mirror the clinical condition of the patient. Some patients present only a moderate anemia throughout the course of the disease while others present a severe anemia apparently out of proportion to the actual lesion. While the general tendency in the average case is for the anemia to increase

with the progress of the disease, this increase is usually not steadily progressive, but is apt to be associated with fluctuations of the red cell count and hemoglobin, as if indicating repeated efforts at blood regeneration in the face of the persistent action of the blood destructive factor.

TABLE II.—CASES OF MALIGNANT DISEASE GRADED ACCORDING TO RED CELL COUNT.

Disease.	No. cases.	5 mil. plus.		4 to 5 mil.		3 to 4 mil.		2 to 3 mil.		1 to 2 mil.	
		Cases.	%	Cases.	%	Cases.	%	Cases.	%	Cases.	%
Ca oropharyngeal cavity	13	1	8	6	46	5	38	1	8	0	0
Ca larynx, epiglot., thyroid	11	1	9	6	55	2	18	2	18	0	0
Ca lung (primary)	24	2	8	9	38	13	54	0	0	0	0
Ca esophagus	11	1	9	3	27	6	55	1	9	0	0
Ca stomach	76	2	2	16	21	30	40	20	26	8	11
Ca colon	18	0	0	6	33	6	33	5	28	1	6
Ca rectum	39	3	7	17	43	12	30	5	15	2	5
Ca biliary tract	14	0	0	3	21	6	43	4	29	1	7
Ca uterus	15	0	0	3	20	7	47	3	20	2	13
Ca ovary	13	0	0	6	46	5	39	2	15	0	0
Ca kidney, hypernephroma	12	0	0	5	42	6	50	0	0	1	8
Ca breast	52	1	2	16	31	22	42	8	15	5	10
Bone sarcoma	12	0	0	5	42	7	58	0	0	0	0
Hodgkin's disease	26	0	0	8	31	13	50	4	15	1	4
Lymphosarcoma	17	1	6	6	35	6	35	3	18	1	6
Total cases	353	12		111		146		58		22	
Average percentages			3.4		32.6		41.4		16.6		6.0

The red blood cell count and the hemoglobin estimations were slightly higher in the male than in the female patients, approximating the normal relationship.

No effect upon the average blood count or hemoglobin estimation was found that could be definitely attributed to the age of the patient.

The average blood picture of the patients who had received some form of surgical or radiotherapeutic interference showed no essential variation that could be attributed to such treatment.

The degree of the anemia in a group of cases is not directly proportional to the duration of the disease. The effect of duration in a group of cases is not one of progressive average anemia, but is rather characterized by a slight but steady increase in the average blood count and in the hemoglobin with increased duration except for a fall in the count in the cases of three years' duration (Table III). This fall may be due to a statistical error and represent merely an insufficient number of cases.

TABLE III.—THE EFFECT OF DURATION OF MALIGNANCY ON THE BLOOD COUNT.

Duration.	Cases.	Hemoglobin.	Red blood cells.
1 year and under	124	61	3,562,000
1 to 2 years	82	63	3,592,000
2 to 3 years	66	65	3,603,000
3 to 4 years	36	55	3,336,000
Over 4 years	54	64	3,657,000

The highest count in the whole series was 6,500,000 in a patient with cancer of the rectum (proven by pathological specimens), subsequently operated upon. This patient showed no sign of recurrence two years after the operation. The lowest count was 960,000 in a patient with advanced abdominal lymphosarcoma.

The cases of cancer of the uterus showed the lowest average blood count. In these cases, hemorrhage was undoubtedly the important factor. Almost as low was the average red cell count in the cases of cancer of the stomach (Table I). In this disease the anemia was particularly severe in patients in whom hemorrhage and marked loss of weight were clinical symptoms. Adenocarcinoma was associated with a more marked anemia than "simple," scirrhous or colloid carcinoma. The lowest red cell count in the cases of gastric cancer was 1,200,000. Although in the majority of cases the anemia was distinctly of the secondary type, we have met rare cases presenting a blood picture and even a clinical syndrome difficult to differentiate from that of primary pernicious anemia. Such a case has been published in detail in a previous paper.[18] The specific pathology of these cases is, as yet, obscure. Some writers[19, 20] explain them upon the basis of a coexistence of two diseases.

In the cases of cancer of the colon, it was found that those involving the proximal portions were associated with a much lower red cell count than those affecting the distal portions of the colon (3,259,000 to 3,778,000 respectively), agreeing with the recent findings of Alvarez and his associates.[21]

Sarcoma is reputed to impoverish the blood more rapidly and to a greater degree[22] than carcinoma, but this has not been confirmed by our experience (Table I). The lowest red cell count on record for sarcoma is 663,000 in a case reported by Hayem.[23] Grawitz's[10] case of cancer of the stomach had a red count of 500,000.

Our series of cases of cancer of the stomach showed a lower average red cell count than that reported by other observers (Table IV).

TABLE IV.—RED CELL COUNTS IN CANCER OF THE STOMACH.

Source of material.	No. of cases.	Red blood cells.	Over 5 mil. Cases.	Over 5 mil. %	Under 3 mil. Cases.	Under 3 mil. %
Cabot	114	4,090,000	25	22	23	20
Johns Hopkins Clinic	134	4,000,000	33	25	16	12
Osler and McCrae	59	3,712,000	10	17	16	27
Eisen	76	3,198,000	2	3	32	42

There were also many more cases with red cell counts of less than 3 million. This is probably explainable by the fact that our patients were practically all in a more advanced stage of the disease than such patients as are seen in a general hospital or clinic. In Cabot's[22] series, there were 4 cases with red cell counts of above 6 million. Osler and McCrae[24] had 3 cases with a count of more than 6 million. These were in patients with cancer of the pylorus with obstruction.

Hemoglobin. The hemoglobin usually begins to fall earlier and to a greater extent than the red cell count so that the color index is usually less than 1. The average hemoglobin in our series was 62 per cent which, with an average red cell count of 3,569,000, gives a color index of 0.88. The average hemoglobin values for the various disease groups is shown in Table I.

The highest hemoglobin values were found in those cases with the highest red cell counts (Table I). The lowest hemoglobin values were found in the cases of cancer of the stomach. The average color index varied between 0.78 and 0.90. In 183 cases, the color index was 0.90 or above. The highest hemoglobin value in the series was 105 per cent in the case of cancer of the rectum mentioned as having the highest red cell count. The lowest hemoglobin value was 15 per cent found in 2 cases of cancer of the stomach. The cases of cancer of the proximal colon had the lowest hemoglobin values (an average of 56 per cent for 12 cases of cancer of the cecum and ascending colon) of all the cases except the cases of cancer of the stomach, agreeing with similar findings by Mayo.[25]

In Cabot's series of 87 patients with malignant disease in whom hemoglobin estimations were made, the average value was 58 per cent with a color index of 0.65. His highest values were 100 and 90 per cent and the lowest 20 and 22 per cent. The color index in the lowest cases was 0.36 and 0.58. In Reinbach's[26] series of 16 cases, the average hemoglobin was 53 per cent, the highest being 70 and the lowest 18 per cent. In Osler and McCrae's series of 62 cases of gastric cancer in which hemoglobin estimations were made, the average hemoglobin was 49.9 per cent with a color index of 0.63. Three of these cases had a hemoglobin of 80 per cent or more and 2 less than 20 per cent. Bierfreund,[27] in his series of 72 cases of cancer, found the rather high average hemoglobin of 68 per cent. This writer also made the interesting observation that following an operation for cancer, the hemoglobin would begin to rise toward normal on an average of about one week later than after an operation for a nonmalignant condition and that it never reached its preoperative level.

White Blood Cells. The average white blood cell count in our series was 10,000 with 71 per cent polymorphonuclears and 23 per cent lymphocytes. The other white cell elements are not detailed because nothing characteristic was found about them. Sixty per cent of our cases presented a normal white count and 36 per cent a leukocytosis and 4 per cent a leukopenia. The white cell and the differential counts for the various diseases are shown in Table V.

It is doubtful if the uncomplicated cancer process has the power to attract leukocytes to the blood. In our cases, very high counts were invariably found to be referable to a complication. Sarcoma is reputed to be associated with an earlier onset and a greater frequency and degree of leukocytosis but this is not borne out by our

figures. Our highest counts were 32,400 in a case of cancer of the lung and 30,000 and 25,000 in 2 cases of Hodgkin's disease. The white cell and the differential counts showed no characteristic variations with the duration of the disease.

TABLE V.—LEUKOCYTE AND DIFFERENTIAL COUNTS IN MALIGNANT DISEASE.

Disease.	Cases.	W. B. C.	Polys.		Lymph.	
			No.	%	No.	%
Bone sarcoma	12	7,600	5,000	66	2,200	29
Cancer of stomach	76	7,800	5,700	73	1,700	22
Lymphosarcoma	17	8,300	5,700	69	2,100	25
Ca of breast	52	8,400	5,600	67	2,200	26
Ca of uterus	15	8,500	5,900	69	2,200	26
Ca of oropharyngeal cavity	13	8,700	6,300	72	1,900	22
Ca of ovary	13	8,900	5,900	66	2,100	24
Ca of rectum	39	9,100	6,300	69	2,100	33
Ca of colon	18	9,500	6,700	70	2,400	25
Ca of esophagus	11	10,400	7,300	70	2,200	21
Ca of kidney, hypernephroma	12	10,800	7,900	73	2,400	22
Ca of larynx, epiglot., thyroid	11	10,900	7,400	68	2,500	23
Hodgkin's disease	26	11,500	8,900	77	2,000	17
Ca of lung (primary)	24	12,000	8,900	74	2,800	23

In the various disease groups, the polymorphonuclears varied between 66 per cent in bone sarcoma and 77 per cent in Hodgkin's disease. The lowest average polymorphonuclear count was 35 per cent in cancer of the ovary, the highest 97 per cent in a case of cancer of the lung. Cabot obtained a polymorphonuclear count varying between 65 and 98 per cent in individual cases. Reinbach's counts varied between 77 and 89 per cent. With a few exceptions, it may be said that, generally speaking, the polymorphonuclear count varies directly with the total white count. The lymphocytes in our series varied between an average of 17 and 29 per cent. On the whole, their percentage was inversely proportional to the polymorphonuclear percentage. Strauss and Rohnstein[28] found an average of 35 per cent lymphocytes in a series of 35 cases.

In his 60 cases of cancer, Weinberg[29] found a normal white count in 40 per cent, somewhat less than in our series. There was leukocytosis in 38 per cent and leukopenia in 22 per cent. In Cabot's series of 86 cases of cancer of the stomach the average white cell count was 10,600. Of these, 51 showed a normal count, 5 a leukopenia and 30 a leukocytosis, the highest count being 40,000. In Osler's series of 62 cases of cancer, there were 14 with a leukopenia, 30 with a normal count and 18 with a definite leukocytosis.

In cancer of the breast, the average white cell count in 17 cases reported by Alexander[30] was 11,400. The counts varied between 21,700 and 2,360. Cancer of the kidney in Cabot's series of 10 cases showed the remarkably high average of 28,000. The highest counts were 43,000 and 91,000. His series of 57 cases of cancer of the liver showed an average count of 13,200. The average white count of his

series of 32 cases of Hodgkin's disease was 11,700, practically the same as ours. Of these, 9 showed a leukocytosis, the highest count being 64,000. Seven cases showed a leukopenia, the lowest count being 1,440. The average polymorphonuclear count was 73 per cent and the lymphocytes 23 per cent. In McAlpine's[31] more recent series of 18 cases of Hodgkin's disease, the average white cell count was 13,000. There was no relationship between the total white count and the duration of the disease. The highest number of neutrophiles was found, as in Cabot's series, in those cases with the highest white count.

To determine the nature of the anemia in cancer, clinical and autopsy studies were made of 21 patients. In no case was there any evidence of any aplasia of the bone marrow either as reflected in the peripheral blood picture or in the character of the bone marrow. The bone marrow picture was usually that of a marked hyperplasia. The parenchymatous organs did not present any evidence of any excessive red cell destruction except in 1 case of abdominal lymphosarcoma (the patient with the count of 960,000 red cells) in which there was a marked increase of the pigment deposits in the spleen. One patient with cancer of the lung showed during life an increase in the serum bilirubin but no autopsy was obtained.

Blood Chemistry. Blood sugar, urea nitrogen and uric acid estimations were made in 182 cases of cancer. Averages were taken in six disease groups (Table VI).

TABLE VI.—BLOOD CHEMICAL FINDINGS IN MALIGNANCY.

Disease.	Cases.	Sugar.	Urea N.	Uric Ac.
		mg. per 100 cc.		
Ca of lung	11	113	16	3.1
Ca of stomach	37	114	19	3.2
Ca of colon	17	115	12	2.7
Ca of rectum	25	113	15	3.4
Ca of breast	28	115	19	4.0
Hodgkin's Disease	8	112	18	2.5

As may be seen, there seems to be no characteristic change in the blood sugar in the various types of malignant disease. The value common to all is that of a high normal. The urea and the uric acid nitrogen are within normal limits.

TABLE VII.—BLOOD CHEMICAL FINDINGS IN RELATION TO DURATION OF MALIGNANCY.

Duration.	Cases.	Sugar.	Urea N.	Uric Ac.
		mg per 100 cc.		
1 year and under	55	110	16	2.9
1 to 2 years	39	111	19	3.6
2 to 3 years	45	115	15	3.4
Over 3 years	43	116	14	3.4

The effect of duration of the disease upon the blood sugar is a doubtful one. There seems to be a slight rise in the blood sugar in the cases of older duration, but this does not seem to be of sufficient degree to be regarded as of any significance.

The average values of our blood sugars are somewhat at variance with those published by other observers (Table VIII).

TABLE VIII.—BLOOD SUGAR FINDINGS IN MALIGNANCY.

Source.	Cases.	Sugar (mg. per 100 cc.)
Friedenwald and Grove	75	157
Forster and Foerster	22	96
Kelly	61	97
Eisen	126	113

In 2 cases reported by Friedenwald and Grove,[32] blood sugars taken before and after operation showed a drop in one case from 198 to 148 and in another from 155 to 88. Lewis and Benedict[33] found experimentally an inverse relationship between the sugar content of the blood and the progress of malignant tumors. Practical application of this finding to human beings was not successful. In Theis and Stone's[34] experience, the blood sugar is apt to be normal in 61 per cent of cases, above normal in 26 per cent and below normal in 13 per cent. These writers also found the urea nitrogen to be low in clinically malignant cases. Uric acid, as a rule, was found to be quite normal. Killian and Kast,[35] however, in a series of 119 cases found an increase in the uric acid in 80 per cent and an increase in the urea nitrogen and creatinin in about 60 per cent, indicating a more or less severe impairment of kidney function. This impairment of renal function was found invariably in abdominal carcinomatosis, in about 90 per cent of cases of carcinoma of the bladder, prostate, uterus and rectum, about 50 per cent of cases of carcinoma of the stomach and rarely in external tumors. No such disturbance of kidney function was found in nonmalignant tumors. The extent of renal insufficiency was independent of the age of the patient and of the associated anemia.

Comment. The explanation of the very marked anemia occasionally seen in some cases—apparently out of all proportion to the size of the lesion—is somewhat obscure. It would seem that there is an individual hypersusceptibility to the effects of malignant tumors. A preëxisting anemia and the patient's general constitutional condition may also play important rôles.

The comparatively high red cell count in the cases of cancer of the respiratory passages and of the esophagus may possibly be due to a masking of the anemia in the first instance by an accompanying increased hematopoiesis associated with cyanosis[36] and in the second instance possibly by a concentrating effect upon the blood serum of a prolonged interference with water ingestion.[37]

The rise in the red blood cell count and hemoglobin percentage in the patients in the older duration groups might perhaps be best explained on the theory that the tumor growth in such patients as survive for a long period must be less malignant in all its properties including that of anemia production.

The histological type of the tumor has a bearing upon the degree of the anemia, which is not specific but which is rather, as Ewing suggests, dependent upon its associated tendency to ulceration. Thus a highly cellular, rapidly growing adenocarcinoma with its marked tendency to produce necrosis and ulceration would be apt to favor hemorrhage and infection and hence be associated with a more severe anemia than the more slowly growing scirrhous and colloid tumors. The same observation would serve to explain the fact that the degree of metastasis and the extent of dissemination did not seem to have any direct bearing upon the degree of the anemia.

The very marked anemia in the cases of cancer of the stomach is probably related not only to the associated hemorrhages but to the highly absorptive nature of the mucous membrane involved and the consequent greater absorption of necrotized tumor products and possibly also to the accompanying achylia. To the latter has been attributed, the major rôle in the production of the anemia in this disease.[38] This view is supported to some extent by the clinical observation that patients that have been subjected to a gastrectomy sometimes subsequently develop a condition of profound primary anemia resembling in every respect that of pernicious anemia.[38, 39] The mechanism of the production of this anemia, it is suggested, may involve either the absence of the bactericidal qualities of the hydrochloric acid present in normal gastric juice or, as suggested by Hartman, the absorption of incompletely digested, toxic, presumably hemolytic, split proteins.

That the malnutrition associated possibly with the achylia in cancer of the stomach, might, in itself, be a factor in the production of the marked anemia in that disease is suggested by the observation that markedly emaciated patients showed a particularly low red cell count and that the anemia was particularly severe in patients with cancer of the pancreas and biliary system, organs intimately associated with the process of digestion.

Although hemolytic properties are frequently ascribed to malignant tumors, actual demonstration of this property has been rare. Only isolated instances of its occurrence have been reported. It occurred in only 1 case in our series. Hemolysis appears to be ordinarily no factor in the production of the anemia in cancer.

The explanation of the marked anemia associated with cancer of the proximal colon seems to be associated with the highly absorptive function of this organ and hence the greater disturbance in metabolism due to absorption of necrotic products than in the distal colon which is largely eliminative in function.

Summary and Conclusions. An analysis is presented of blood counts and the chemical condition of the blood in 353 cases of malignant disease. The average red cell count in the series was 3,569,000 with a hemoglobin of 62 per cent and a color index of 0.88. The average white cell count was 10,000 with 71 per cent polymorphonuclears and 23 per cent lymphocytes.

One gains the impression that the degree of anemia is dependent upon many processes—actual blood loss through chronic, persistent hemorrhage and malnutrition (possibly associated with achylia) play important rôles. Hemolysis and aplasia of the bone marrow are not found as factors in the production of the anemia in cancer. No effect upon the average anemia could be found that could be definitely attributed to the age of the patient or to any radiotherapeutic or surgical treatment received.

The most severe anemia was found associated with cancer of the stomach. In this disease, the anemia was particularly marked in patients in whom hemorrhage and marked loss of weight were important clinical symptoms.

Adenocarcinoma was found to be associated with a greater average anemia than scirrhous, colloid or "simple" carcinoma, presumably due to its greater tendency to be the cause of hemorrhage, ulceration and infection as well as a higher average of malignancy.

No definite relationship was found between the extent of involvement or the degree of dissemination and the degree of the anemia.

The patients in the older duration groups presented a less severe anemia than those in whom the disease was of less duration, presumably due to the fact that the malignant tumor in such patients was less severe in all its properties.

The average blood sugar was 113 mg. per 100 cc. The average urea nitrogen and uric acid were within normal limits.

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THE EFFECT OF EXTERNAL TEMPERATURE ON THE SEDIMENTATION RATE OF THE RED BLOOD CORPUSCLES.

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The increasing importance of the sedimentation test as a diagnostic and prognostic aid in many pathologic disorders makes it imperative that it be performed under uniform control conditions. One of the fundamental requisites, the importance of which has not been stressed, is a standard temperature at which the test is to be carried out.

During the course of an investigation of the sedimentation speed of the red blood corpuscles in normal children, it was noted that on very hot summer days the rate of sedimentation was markedly accelerated above that which we had considered as the normal for children of similar ages.

We were acquainted with the experiments of Fahraeus[1] in which he demonstrated the effect of changes in the internal temperature of the blood upon the sedimentation rate of the erythrocytes. The children who supplied the blood for our investigations were normal and had normal temperatures, and we, therefore, felt that the causative factor of the accelerated rate was to be found in some external condition. As the same phenomenon occurred on a second hot day but not on a mild one, it was plausible to consider that the increased heat of the day was the external influence which we were seeking. A study of the literature was then undertaken to ascertain the effect of external heat on the sedimentation time of the red blood corpuscles. While it is a well-known physicochemical fact that blood serum and blood plasma as well as other solutions of protein substances are radically changed by higher degrees of heat, we were unable to find very much definite information in the literature on the influence of external temperature. There are occasional references to the importance of performing the tests at average room temperature and others to the effect that they should be carried out under average room temperature but the greater number of publications on this subject ignore the question of external temperature entirely. One communication, however, that by Benischek and Douglas[2] makes the following definite statement: "The blood must

be kept at an average room temperature. Keeping it in an ice-box we obtain almost the same results as in room temperature but if it is kept in an incubator, a highly increased speed is produced."

No further data were furnished by these authors. Because of this scarcity of information on a phenomenon which seemed fundamentally important, it was decided to undertake the experiments described in this report.

The blood to be tested was obtained from adults presenting the following conditions: normal healthy male, 1; hypertension, 1; postoperative, 1; diabetes, 2; diabetes and surgical infection, 1; arthritis, 1; antepartum state, 8. There were 2 males and 13 females; 50 tests were made on the blood of these 15 patients.

The experiments were carried out in the regulation Linzenmeier sedimentation tubes graduated at 1 cc. and at intervals below this at points designating 6, 12 and 18 mm. The blood was obtained by venipuncture and 4 cc. were added to 1 cc. of a 5 per cent solution of sodium citrate. After thorough shaking, 1 cc. of the mixture was poured into each one of 3 sedimentation tubes which were then placed in one of the following locations: one in an incubator at 37° C., another in a refrigerator at 10° C. and the third on the laboratory table in a room with a temperature ranging from 22° to 24° C.

Prior to the experiments, the empty test-tubes were kept at the temperature at which they were to be used for fifteen minutes. They were then filled with the citrated whole blood up to the 1-cc. mark, the time noted and then kept at the designated temperature only during the time it took for the red blood cells to sink to the 18-mm. mark.

In several instances, the blood was shaken again at the completion of the test and the tubes interchanged, placing the one from the refrigerator in the incubator and *vice versa*. It was found that the sedimentation rates in the new locations were practically the same as if the tube had originally been placed there. This proved conclusively that we were dealing with a reversible reaction and that the influence of the external temperature was very transitory, disappearing promptly with the removal of the test-tube from that environment.

The findings, as shown in the table p. 213, demonstrate that the effect of external temperature on the sedimentation rate is definite, irrespective of the diseased condition present or of the original sedimentation rate. There is an acceleration in the sinking velocity with an increase in the external temperature and a marked diminution in the rate with a decrease in the temperature. Intermediate temperatures show intermediate sedimentation values. Not a single instance was found in which this series of reactions failed to appear. In some bloods, the erythrocytes sank twice as fast at 37° as at 10°C. There is an appreciable difference also between the rate as observed at 10° and at 23° C. so that we cannot agree with the

observation of Benischek and Douglas[2] that they obtained almost the same results in the ice-box as in room temperature.

SEDIMENTATION TIME OF RED BLOOD CELLS—EXPRESSED IN MINUTES FOR 18 MM. SINKING.

Disease.	Citrated blood at 10° C.	At 23° C.	At 37° C.
Normal male	510	240	190
Hypertension	410	320	260
Postoperative	54	30	22
Diabetes and infection	20	16	12
Arthritis (male)	310	240	120
Diabetes	205	160	95
Antepartum, 9 months' gestation	75	48	37
Antepartum, 8 months' gestation	110	70	60
Antepartum, 9 months' gestation	65	42	26
Antepartum, 9 months' gestation	90	75	60
Antepartum, 6 months' gestation	140	95	70
Antepartum, 5 months' gestation	110	80	60
Diabetes	285	190	110
Antepartum, 7 months' gestation	48	30	21
Antepartum, 8 months' gestation	68	45	32

(The shorter the time consumed, the greater the sedimentation rate, and *vice versa*.)

Discussion. According to Fahraeus[1] the sedimentation rate depends upon several factors. The rate of the sinking of the red blood cells varies inversely with the agglutinating powers of the plasma, the viscosity and the suspension stability. An increase in the agglutination and in the viscosity gives rise to a more stable suspension as a result of which the corpuscles sink more slowly. Conversely a decreased agglutination and a diminished viscosity produce a less stable suspension, permitting the red blood cells to sink more rapidly, with, of course, a diminution in the time consumed. A slow sinking rate means a longer sedimentation time. Fahraeus concluded that the suspension stability is changed when the blood is kept for a number of hours at different temperatures.

His experiments were carried out on whole blood, defibrinated blood and on various combinations of the component parts. These were heated for a number of hours, five or seven, by being immersed in water of various thermostats. At the end of the specified time the test-tubes were removed from the containers and allowed to assume the temperature of the room. The sedimentation rate was taken. The change in the plasma or serum produced by the heat treatment persisted for hours after the treatment had been discontinued, it taking that length of time for the heated material to assume room temperature.

Fahraeus' experiments demonstrated the influence of prolonged heating of the blood on the sedimentation properties. In our experiments, the test-tubes with blood were kept at a definite temperature only for the time necessary for the completion of the reaction, the time consumed by the drop of the erythrocytes to the

18-mm. mark. His results show the effect of internal temperature while ours demonstrate the influence of external temperature.

As stated above, the effect of internal heating may last for hours. That of external temperature, according to our findings, is more of a transitory nature and disappears promptly on removal. A reversible action is obtained by shaking the mixture and placing it in another location under the influence of a second temperature. The blood of a pregnant woman with a very rapid sinking rate will show a marked slowing in the velocity when exposed to a temperature of 10° C. in an ice-box. In general, the sinking rate assumes that of the latter temperature in the same or nearly the same length of time that an original would.

Our experiments also show that if it is not feasible to complete the test in the room in which it was taken, the tube may be carried to the laboratory, shaken and then exposed to a known constant temperature. The rate of sedimentation must be computed from the time of the second shaking and not from that of the first.

Summary and Conclusions. Observations were made on the sedimentation rate of the red blood cells of adults in an attempt to determine the effect of external temperature on the sinking velocity. Each sample of blood was mixed with 5 per cent solution of sodium citrate and then divided into three parts, each portion being placed under a different temperature (10° C., 23° C. and 37° C.) and permitted to sediment at that temperature. In some instances after the first test, the tubes were interchanged and retested at new temperatures.

External temperature exerts an influence on the sedimentation rate of the red blood cells. Higher temperatures accelerate the rate and lower temperatures diminish the velocity. Intermediate temperatures give intermediate results.

The effect of external temperature is transitory and is not as lasting as that of internal temperature (prolonged heating).

Shaking and retesting the blood at a second temperature will show no influence of the original temperature.

All observations on the sedimentation test must be performed under properly controlled conditions with a standard known temperature. As the average room temperature is between 22° and 24°, a standard of 23° C. should be maintained for all such investigations. This adoption of a standard temperature is especially necessary for the comparison of the results of various investigators. Seasonal variations showing the effect of extreme heat in the summer and of cold in the winter must be taken into consideration in the interpretation of results, unless controlled by uniform standard experimental conditions.

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THE SIGNIFICANCE OF ARSENIC IN THE EXCRETIONS.*

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Although the toxicology of arsenic has been a subject of investigation for generations, recent observations have shown that much remains to be learned in regard to the behavior of this substance in the body. The intolerance to arsenic shown by certain individuals, the part it plays in the production of severe and sometimes fatal reactions, especially as affecting the liver, its association with numerous forms of skin disease, the unexpected discovery of the mineral in the excretions of those not known to have been subjected to its influence, and the means by which it gains access to the body are all questions that still require study. It is an uncanny thought to realize that this lurking poison is everywhere about us, ready to gain unsuspected entrance to our bodies from the food we eat, the water we drink, and other beverages we may take to cheer us, the clothes we wear, and even the air we breathe. Alleged long ago to be a normal constituent of the body, though this contention was much disputed, renewed interest is now being taken in its occurrence in the tissues and excretions of those without any symptoms of poisoning. It is as a contribution to this phase of the subject and to the possible importance of slight degrees of arsenic retention that the following observations are presented:

The conclusions arrived at are based on a consecutive series of 100 patients on whom, for various reasons suggested by their clinical condition, tests for arsenic were carried out during a period covering approximately the past three years. In these cases 240 tests were made, 135 times on the urine, 62 times on the stool, and in the remaining 43 instances on spinal fluid, vomitus, skin, liver and so forth. In the excretions from 69 of the 100 patients arsenic was found, while in the remaining 31 the results were negative. In 34 of the cases that were positive, this was to be expected, since arsenic had been administered either recently or remotely in the form of salvarsan, Fowler's solution, or cacodylate. There remain 35 cases in which arsenic was being eliminated, although it was impossible to ascertain in what manner it had entered the body.†

* Read before the Medical Society of the County of New York, October 24, 1927.

† It is needless to say that every effort was made to eliminate the possibility of error by frequently checking the chemicals and apparatus by blank tests and by carrying on determinations on normal material simultaneously with the unknown. The organic matter in the substance to be tested was destroyed by heating with a mixture of sulphuric and nitric acids, and the clear colorless fluid resulting tested by the Marsh Berzelius or Gutzeit methods.

In passing, and as confirmation of the generally accepted belief in the rapid passage of salvarsan from the veins to the spinal canal, it is interesting to note that in fourteen observations made on 6 patients to whom neosalvarsan or silver salvarsan was given intravenously, the spinal fluid withdrawn two hours later showed the presence of arsenic. In most cases 0.3 g. was given, but in 2 cases after 0.1 g. and in 2 others after 0.2 g. the arsenic was found as noted. In 1 case after 0.1 g. which was positive after two hours, on the next day the spinal fluid was negative.

We are especially concerned with 40 cases in which jaundice was a symptom. In 6 of these cases no arsenic was detected, but in 34 others the results of the tests were positive. Six of these were cases in which it was known that salvarsan or cacodylate had been given, as follows:

Case Reports. CASE XVI. A housewife, aged forty-three years, with a negative Wassermann test and a bile index of 83, had received 10 salvarsan injections during the past year. After the last, shortly before admission, she began to get jaundiced and the liver was enlarged. Stools and urine were positive for arsenic. Diagnosis: Multiple sclerosis and arsenical hepatitis.

CASE XXVIII. An insurance agent, aged forty-six years, with a +++ Wassermann and a bile index of 88, following the seventh salvarsan injection ten days before admission became jaundiced. Stools and urine positive for arsenic. The spleen was palpable, the liver not enlarged. Thiosulphate was given. Diagnosis: Tertiary lues and arsenical hepatitis.

CASE XXX. A housemaid, aged thirty-nine years, with a negative Wassermann test, three weeks before admission was given 0.45 g. of neosalvarsan as a therapeutic test for a bruise on the leg of two years' duration. This was followed by nausea and vomiting. Ten days later a similar injection was followed by a very severe reaction with chill, high fever, vomiting, and abdominal pain. The liver dullness was only 4 cm. in width and the bile index 132. The urine was positive for arsenic. Diagnosis: Arsenical hepatitis.

CASE LVII. A housewife, aged twenty-nine years (Wassermann anticomplementary), seven weeks before admission was given several injections of what is supposed to have been cacodylate. Three weeks before admission she began to be jaundiced. The liver was tender, but not palpable; the bile index, 285. Urine and stools were positive for arsenic. Diagnosis: Arsenical hepatitis.

CASE LXII. A housewife, aged twenty-six years, with negative Wassermann test, had had several courses of salvarsan, the last dose three months ago. Two weeks before admission she had nausea and vomiting, jaundice beginning one week later. The urine and stool were positive for arsenic; the bile index 200. Diagnosis: Arsenical hepatitis.

CASE LXIV. A chauffeur, aged twenty-four years, with negative Wassermann test, had one salvarsan injection a week before admission, followed a few days later by jaundice; the bile index was 27; the stool and urine were positive for arsenic. Diagnosis: Arsenical hepatitis.

Of especial interest are the 28 cases of jaundice in which arsenic was found, but in spite of careful investigation no explanation for its presence could be ascertained. Here the perplexing situation arises of making a decision as to whether the arsenic is in the body merely fortuitously, or whether it is an active or possibly only contributing cause in the production of the symptoms. Of these patients, 2 left against advice before adequate study of their cases had been carried out, 1 was a case of carcinoma of the kidney ending fatally, and 8 ran the course of a simple catarrhal jaundice.

The remaining 17 deserve somewhat fuller mention, especially as in 9 of the number death resulted.

CASE VI. A woman, aged thirty-six years, was admitted with a bile index of 50 after a week's illness. She died sixteen days later, exhibiting the usual picture of acute yellow atrophy, and this was the autopsy diagnosis, with bronchopneumonia and parenchymatous degeneration of the kidneys. The urine and stools contained arsenic.

CASE XVIII. A chauffeur, aged fifty-two years, died on the seventeenth day of his illness, which was characterized by nausea, vomiting, fluctuating fever and chills. Wassermann ±. Bile index 190. Autopsy diagnosis: Acute yellow atrophy of liver; parenchymatous degeneration of kidneys; bronchopneumonia; hemorrhages in spleen. Arsenic was identified in the liver. One day before the onset of his illness, he drank some liquor from a questionable source.

CASE XXIX. A man, aged seventeen years, became ill five weeks before admission with jaundice, the liver edge 3 cm. below costal margin, the bile index 312. The urine contained arsenic. His work was in a storage battery company, where he was exposed to acid fumes. He was treated with thiosulphate and discharged cured eight weeks after the onset of his illness.

CASE XXXI. A shoemaker, aged thirty-five years, had jaundice varying in intensity and abdominal pains for three months. The Wassermann test was negative; the bile index 85. Arsenic was found in the urine. He died one month after admission, following an omentopexy for cirrhosis of the liver. The autopsy diagnosis was perilobular cirrhosis of the liver, chronic pancreatitis and splenitis; gastric hemorrhage.

CASE XXXV. A candymaker, aged twenty-two years, had jaundice for two and a half months; for the past nine weeks pain in right upper quadrant and vomiting. The Wassermann test was negative; the bile index 266. The urine and stool contained arsenic. A biopsy was done and microscopic study of the liver showed acute hepatitis. The patient was finally discharged convalescent, but not entirely well.

CASE XXXVIII. A bricklayer, aged thirty-two years, had been suffering from nausea and vomiting for three weeks. Jaundice began three days before admission. The Wassermann test was ++++; the bile index 166. He was stuporous on admission and died two days later. Diagnosis: Acute yellow atrophy of the liver.

CASE XLII. A housewife, aged fifty-two years, had been suffering from abdominal pain, nausea, and vomiting for five weeks. The Wassermann test was negative; the bile index 200. The urine and stool contained arsenic and under treatment with thiosulphate the amount diminished, but did not wholly disappear. She was discharged a month later with the diagnosis of acute hepatitis.

CASE XLIV. A housewife, aged forty years, had suffered for two years from pain in the right upper quadrant. The Wassermann test was negative; the bile index 138. The spleen was much enlarged, and blood examination showed marked secondary anemia and greatly increased fragility of the red cells, which were completely hemolysed in salt solution as high as 0.58 per cent in strength. The urine and stool contained arsenic. Following splenectomy and removal of the gall bladder with numerous stones, she improved and after five weeks was discharged with the diagnosis of acquired hemolytic anemia, chronic cholecystitis and cholelithiasis.

CASE XLVII. A retired policeman, aged sixty years, began to be jaundiced ten days previously without fever or pain. On the morning of admission he became delirious and he died two days later. The Wassermann test was negative; the bile index 176 and the urine contained arsenic. Diagnosis: Acute yellow atrophy of the liver.

CASE LIII. A housewife, aged thirty-seven years, for four weeks had suffered from cramping pain under the sternum, distension and vomiting; jaundice for the past week, and tenderness over the gall bladder. The bile index was 73. The diagnosis of gall stones was made, but at operation none were found, nor could any other pathological condition be discovered. A piece of liver removed for examination showed chronic perihepatitis. The urine and stool contained arsenic. The patient became delirious soon after the operation, and died one month after admission.

CASE LXVII. A colored housewife, aged thirty-eight years, had been suffering from nausea for three weeks, and jaundice for four days. There was no pain. The Wassermann test was negative; the bile index 176. The urine and stool contained arsenic. Twelve days after admission she suddenly vomited a large amount of blood, and had black stools. She was transfused twice, but died two days after the hematemesis. The autopsy showed an ulcer 1.5 cm. in diameter midway between the cardia and pylorus, toxic hepatitis and cholelithiasis.

CASE LXVIII. A housewife, aged twenty-eight years, for a year had been suffering from periodic attacks of epigastric pain, vomiting and jaundice. The last attack began two weeks before admission. The Wassermann test was negative; the bile index 30. The urine contained arsenic. At operation gall stones were found, and cholecystectomy was done.

CASE LXIX. A domestic servant, aged thirty-nine years, four months before admission had an attack of jaundice lasting two weeks. This cleared up, but one week before admission the jaundice recurred. The Wassermann test was negative; the bile index 87. The stool and urine contained arsenic. Cholecystectomy with drainage was done but the patient died two days later with increasing jaundice. The pathological examination showed acute cholecystitis and acute hepatitis.

CASE LXXII. A housewife, aged thirty-four years, had suffered from gastric symptoms for a year, and three weeks before admission she developed jaundice without pain. The Wassermann test was negative; the bile index 62. The urine contained arsenic. The common duct was drained and a piece of liver removed for examination. The biopsy showed cholecystitis and hepatitis.

CASE LXXVII. A woman, aged fifty years, one month before admission developed epigastric pain, nausea and vomiting, and jaundice. Her

Wassermann test was negative; the bile index 137. A heavy arsenic reaction was obtained from the urine. She was operated on and a cholecystectomy done with removal of a stone from the common duct. She became stuporous on the second day after operation, had suppression of urine on the third day, and rapidly became uremic. The jaundice did not decrease, and on the sixth day she died. The autopsy showed kidneys that appeared healthy looking except for jaundice and a few small fresh hemorrhages in the pelves. A piece of liver from the autopsy showed the presence of arsenic.

Case LXXVIII. A housewife, aged thirty-four years, had been suffering from gastric symptoms for a year. One month before admission she developed fever and jaundice without pain, nausea or vomiting. The Wassermann test was negative; the bile index 86. The urine contained arsenic. The common duct was drained and she was discharged with the diagnosis of hepatitis, intrahepatic jaundice and cholecystitis.

Case LXXX. A housewife, aged forty years, complained of vomiting and burning in the pit of the stomach that had begun ten days before admission. Her urine contained both arsenic and mercury. In an attempt to find a possible source for the arsenic some bismuth powders she had been taking were analyzed and found to contain a trace of the mineral, but not enough to explain the condition. There was a decided functional element in her symptoms, and although the vomiting lasted for days, she was finally discharged in good condition.

Comment. Here are 17 cases with no less than 9 deaths in most of which pain in the liver region and vomiting were associated with jaundice and the presence of arsenic in the excretions, and in 11 of these the existence of severe liver damage was proven by microscopic examination of material obtained either by biopsy or at autopsy. Of the 9 patients in the series who were subjected to operation, 4 died within a day or two, without experiencing the relief that was to be expected, and in spite of the fact that they were of a type in which no such outcome would ordinarily be regarded as likely. It is only reasonable to conclude that some unusual factor complicated the situation and to consider that the presence of arsenic might possibly furnish the explanation. There is also ground for speculation as to the part played by the poison in the other cases of the series of 27 in which arsenic and jaundice were associated, and it is suggestive that of the 40 cases of jaundice studied, only 6 were found free from arsenic.

It is the liver that bears the brunt of the arsenic damage. Weiss and Raiziss[1] have found that as a depot for arsenic storage the liver comes first in point of concentration, followed in this order, by the kidneys, spleen, and intestines. Obregia and Carniol[2] detected arsenic in the bile twenty-five minutes after the intravenous administration of neosalvarsan, and Frenkel-Heiden and Navassart[3] found the elimination of arsenic in the feces about eight times as great as in the urine, presumably through resorption from the bile. The liver cells are therefore especially exposed to injury by the poison.

The synergistic action of two or more agencies in producing certain forms of parenchymatous lesions is also recognized. For example, there is much to support the view that alcohol alone will not produce cirrhosis of the liver, and that the characteristic tissue changes do not result unless the organ has been injured by some other toxic agency, such as that of syphilis, or as Mallory has pointed out, by chronic copper poisoning. Mallory[4] has been able to demonstrate the very widespread contamination of foods and beverages by utensils made of copper (he warns especially against cocktail shakers of this metal), and the consequent prevalence of unsuspected chronic copper poisoning. This, with the liver damage it involves, he believes is responsible for not only for hemachromatosis and bronzed diabetes, but also for alcoholic cirrhosis, the alcohol and copper together giving rise to the lesions. Another case in point is the production of optic atrophy. The ophthalmologists* find that arsenic alone will not cause this and that massive doses can be given without injury unless the patient is a heavy user of alcohol or tobacco, or, I should add, is a syphilitic. In other words, toxic agencies like alcohol, tobacco, copper, arsenic, syphilis, infection, when two or more of them are coexistent, may be followed by tissue changes which could successfully be withstood if only a single deleterious factor were at work. Even a simple so-called catarrhal jaundice is accompanied by a greater or less degree of hepatitis with attendant damage to the parenchyma cells. Heyd,[5] Mateer and Henderson,[6] and others have recently pointed out that in chronic disease of the gall bladder and biliary ducts some degree of hepatitis is almost invariably present, as either a primary or secondary lesion. In some instances, the cholecystitis is of less importance than the changes in the liver, and these lead to hepatic insufficiency after operation. The thought therefore presents itself that in the presence of even only minimal amounts of arsenic which ordinarily would be of little significance, a supervening catarrhal jaundice, or infection—cholecystitis, cholangitis, hepatitis—may so far reduce the eliminative capacity of the organ as to permit a more serious degree of arsenic retention to take place with consequent tissue injury and impairment of function. On the other hand, the converse is also likely to be true, and even relatively small amounts of arsenic in the liver may so far lower the resisting power of the tissues as to make the organ unable to cope with a supervening infection. In this way a vicious circle may be initiated, ultimately leading to the fatal consequences noted in our cases. As Rous[7] has pointed out and expressed in a telling phrase, "the liver is the most silent of organs if only a moderate fraction of its cells are in a healthy state. The ducts from as much as three-fourths of its substance can be abruptly obstructed without causing any clinical disturbance." That is to say, the organ's margin of functional reserve is very great, and it is conceivable that a considerable degree

* Personal communication from Dr. Alfred Wiener.

of arsenic poisoning can be withstood without any symptomatic evidence, until some intercurrent stress, like an infection turns the scale and impairment of function finally results, as shown by the appearance of jaundice.

No doubt similar instances of unlooked for and puzzling serious or even fatal complications following hepatic operations will recur to the memory of many surgeons. It would seem a reasonable precaution in cases where operations on the biliary tract are contemplated under conditions that are to any degree atypical, first to have the excretions tested for arsenic. If this should be found, a course of thiosulphate treatment should precede the operation. Meyers[8] believes that if under thiosulphate treatment a definite increase in arsenic elimination is observed this is an indication of the retention of toxic amounts.

It is significant to note that arsenic was found in the liver in 1 of 4 cases of acute yellow atrophy of the liver recently reported by Packard and Adler.[9]

A noteworthy contribution to the subject is a recent report by Throne, van Dyck, Marples, and Myers[10] who found arsenic in the urine of patients suffering from numerous skin conditions, including eczema, scleroderma, leukoderma, psoriasis, pemphigus, oculomotor paralysis, and pigmentation. Particularly interesting are their conclusions in regard to eczema, for they believe that arsenic is present in at least 30 per cent of all cases of this disease. In some of these it seems to act as an exciting cause, the symptoms appearing almost at once after contact with arsenic; in others it appears to be deposited in the skin and to sensitize it so that when later the patient is exposed to a minor irritant the reaction is in the form of eczema. This conclusion is evidently comparable to the one we have just drawn in regard to the action of arsenic in the production of reactions on the part of the liver.

Although the frequency with which arsenic occurs in the bodies of apparently healthy individuals is not generally understood by medical men, the question is naturally of great forensic importance and medicolegal investigators have given the subject much consideration. Gautier[11] in 1899 published the results of an exhaustive study in the course of which he found arsenic in a long list of human and animal organs and tissues and claimed that it was a normal constituent of the human body. In 1920[12] he modified his first conclusions somewhat, admitting that his earlier values had in some cases been too high, but still upheld his main contention. Several other analysts, such as Bertrand, Schaeffer, and Pagel, reached similar conclusions, but among those who differed with him are Cermy, Ziemke, Weser, Bloemendal, and Warren,[13] who in many analyses of human and animal tissues found arsenic either absent or present only in traces, and inferred that arsenic could not be regarded as normal to man. Shattuck,[14] however, has asserted that in the United States the urine of many healthy persons contains

arsenic, and Putnam[15] found it in 30 per cent of 150 samples examined. Sanger found it in 20 cases,[16] and Hills[17] analyzed the urine of 180 persons, 75 per cent of which were positive. Myers and Cornwall,[18] in the course of the monumental researches on the question of arsenicals in the treatment of syphilis carried on under the direction of the late Dr. John A. Fordyce, devoted an especial inquiry to this phase of the subject and reached conclusions much in accord with those of Gautier. Basing their view on the results of analyses of a large number of individuals taken at random, they conclude that arsenic in most cases is a normal constituent of the urine, depending upon dietary conditions of the individual or the use of medication, taken internally or as external applications. From several hundreds of animal experiments it was established that arsenic was deposited especially in the liver, spleen, and under certain conditions, the kidney.

The recognition of the frequency with which arsenic occurs in the human tissues leads to a consideration of the question as to how it can gain access to the body with such facility. At first sight it seems somewhat perplexing that so powerful a poison should so universally be found in persons leading commonplace lives in an ordinary environment, but a little investigation reveals the fact that the world we inhabit is permeated by this subtle poison so that the possibilities for its accidental absorption are countless. The air, water supplies, dust, soil, food, drugs and articles of wearing apparel and household use are all potential sources of arsenic poisoning, and in different regions some one of these factors may be especially operative. Most of the ores of the heavy metals are arsenic-containing sulphids, like iron pyrites, galena or lead sulphid, and the ores of zinc, copper and antimony, so that in districts where mining and smelting are carried on, the atmosphere is heavily charged with the poison. It is stated that the dust from the lead smelters in Colorado and Utah may contain as much as 60 per cent of arsenic, and an epidemic of "sore nose" among the horses in the Montana and Utah ranges was traced to arsenic-containing smelter smoke which was carried to the grazing grounds. Even in cities coal smoke may serve as a means of distributing the poison, and it has been found in illuminating gas. The widespread use of Paris green, copper aceto-arsenite, and also recently of arsenate of lead, as insecticides in agriculture gives abundant opportunities for contamination of the air, the soil and secondarily of water supplies. When one considers the barrelfuls of such sprays with which truck gardens and orchards are deluged year after year, the quantity of arsenic ultimately reaching the earth must be very great. Calcium arsenite is now generally used in cotton fields to combat the boll weevil, and the U. S. Public Health service employs a 1 per cent solution of Paris green to kill anopheles mosquitos. For both purposes spraying fields or swamps with arsenic-containing dust from airplanes has been proposed and is being done in several states.

Vegetables, fruits and tobacco grown in arsenical soil have been shown to contain the poison and numerous epidemics of poisonings have been traced to well water or other forms of water supply. Lead arsenate is generally replacing Paris green for agricultural purposes, and of course adds the possibility of lead poisoning to the already existing danger. Fruit sprayed with arsenicals has given rise to epidemics such as the recent one in England due to apples imported from this country, and another one not long ago in New Jersey when an outbreak of gastrointestinal symptoms at first ascribed to what was called "devil's grip," a term somewhat reminiscent of medieval terminology, was finally found to be caused by the consumption of peaches from arsenic treated orchards. Beer has occasioned numerous instances of wholesale poisoning, such as the one in Halifax in 1892 due to drying the malt in air heated by arsenic-containing coal. One of the gravest was the outbreak of arsenic poisoning in 1901 in Liverpool, Manchester and the Midland counties of England in which 6000 persons were affected, and 70 deaths resulted. It was found that some of the samples of the beer contained from 1 to 3 g. of arsenic per gallon and that it came from the glucose employed, which had been made from starch by the use of sulphuric acid heavily charged with arsenic, some of the analyses showing as much as 2 per cent of As_2O_5. Sulphur used in bleaching wines, fruits, and hops has been found to contain arsenic and analyses of hops, dried peaches, apricots and apples have all shown contamination. Impure glucose of course can easily be the source of arsenic in pastry and confectionery. Several of our analyses have shown arsenic in drugs, and it has been reported in a long list of those commonly used, such as bismuth salts, magnesium and sodium sulphate, sodium bicarbonate, glycerin, tartaric acid, ferric chlorid, and so forth. Myers has found it even in that humble panacea, rhubarb and soda mixture, and states that it can be absorbed from such external applications as ichthyol, sulphur ointment, and calamine lotion. In the *Journal of the American Medical Association* an analysis was recently given of two arsenic-containing proprietary hair tonics. Weed killers, fly papers, and moth destroyers intended to be dusted or sprayed over carpets or garments usually owe their effectiveness to arsenic. It has been found in an endless variety of articles in common use, such as silk, leather hatbands, the glazed paper used in kindergartens or for playing cards, fancy boxes and as wrappers for confectionery, in colored tapers, toys, and artificial flowers, and in materials used for floor coverings and wall hangings. A case of scleroderma recently reported was traced to the arsenic in the glazed paper the patient used in his work. Wall papers, which formerly were often colored with Scheele's green, are now usually dyed with harmless pigments and are less frequently a source of poisoning, but we have found arsenic in two samples of paint. In each instance symptoms referable to the poison developed in persons inhabiting the rooms in question.

Arsin, or arseniuretted hydrogen, because of its high arsenic content and ready absorbability, is the most toxic of the inorganic compounds of arsenic. Even in mild cases of poisoning jaundice is a constant symptom. It is generated when impure commercial acids are brought in contact with metals as in the case in many industries and in storage batteries. In this connection it is interesting to recall that 3 of our patients were chauffeurs.

From the foregoing superficial review it is clear how many and various are the sources from which the man in the street may acquire arsenic. No reference has been made to the numerous industries in which arsenic poisoning is an occupational disease, but it may be mentioned that the manufacture of Paris green is the most important form of arsenic production in the United States, and that the two chief centers for this are Chicago and Brooklyn.

Conclusions. Owing to the great number and variety of possible sources of access to the body, arsenic is found in the excretions of many individuals without discoverable cause, and without giving rise to symptoms.

In the series here reported it was found with especial frequency (85 per cent of 40 cases) in patients suffering from jaundice.

In 9 out of 34 cases in which arsenic and jaundice occurred simultaneously, death resulted. In 4 of these cases death promptly followed an operation on the biliary tract.

If arsenic is found in the urine of a patient with jaundice, eliminative treatment with thiosulphate should, if feasible, be carried out before any operation is undertaken.

It is probable that in many of the cases reported as acute yellow atrophy of the liver arsenic was a contributing factor, with infection as another element in producing the lesions.

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PARASITOSIS OF THE BILE PASSAGES AND GALL BLADDER.

A Report upon 37 Instances of Protozoiasis and One Instance of Infestation by Necator Americanus.*

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In December, 1917, I had the good fortune to secure at operation a large gall bladder, unopened and complete, which had been removed from the manager of a north central Mexican ranch by the late Dr. A. J. Ochsner. At that period, I was conducting bacteriologic studies of gall-bladder contents obtained at operation. The recently removed gall bladders were given to me intact, with cystic duct ligated. Under sterile precautions, in an adjacent laboratory, various media were inoculated with gall-bladder contents but a few moments after the cholecystectomies. It was also my custom to study smears and hanging-drop preparations of the cystic bile in salt solution, in order to become familiar with the cystology and crystallography of fresh bile.

In the gall bladder above mentioned, I was surprised to find large numbers of very actively motile giardiæ (*Lamblia intestinalis*, Stiles, 1902). Associated with this flagellate were numerous short chains of streptococci, great numbers of colon-type bacilli, plaques of edematous, disintegrating epithelial cells and a rich deposit of cholesterin. So far as I am aware, this observation of giardia in the gall-bladder contents of man was the first of record. Very few instances (if any) have been reported since. The case was presented in my discussion[1] of Dr. Hemmeter's address on intestinal giardiasis to the American Gastro-enterological Association in 1920.

My patient had been a "bilious" dyspeptic for many years, but never had he experienced the intestinal disturbances (diarrhea or obstinate stasis, "bloody flux" or the like), supposedly accompanying enteric giardiasis. During his five weeks' hospital residence, I diligently studied dozens of warm, recently passed stools, following saline catharsis, but never found either vegetative or encysted giardiæ. Nor in the vomitus or the gastric lavage returns, during the days immediately succeeding operations, were organisms demonstrable. The patient made an uneventful recovery, returned to Mexico and when last heard from (1921) was "in the pink," as he wrote.

This experience naturally led us to search carefully for protozoa in all the gall-bladder contents. After unavoidable interruptions for several years it was again begun when we undertook the routine performance of Lyon's[2] meta pyloric-duodenal biliary-tract drainage.

* Presented at the Annual Meeting of the American Society of Tropical Medicine, Washington, D. C., May 10, 1926.

Scattered reports of protozoa (mainly giardiæ) may now be found (Boyd,[3] Simon[4] and others). In view of our studies, it is strange that during the observations of these clinicians upon giardiæ, other protozoa were not seen. Kantor,[5] who reviewed the duodenal incidence of giardiasis and reported an instance from his own practice where that flagellate was found during biliary-tract drainage, believed that the habitat of the parasite was the gall bladder. Freedom from the flagellate followed frequent duodenal drainages and the exhibition, intravenously, of large doses of neoarsphenamin. He does not however, record the finding of other protozoa in the biliary tract.

More recently, Lyon[6] has reported exhaustively upon general alimentary tract giardiasis; but while he states that, in the returns from a series of 798 patients drained by tube metapylorically, giardiæ were found in 31 instances, (from the "*gall bladder*" fraction in 5), Lyon does not mention the simultaneous or independent occurrence of other protozoa.

From our experience presently to be detailed, it is difficult to understand how, in so large a material as Lyon's and of such divergent geographic distribution, giardia only should occur. It may be that certain sections of the country are richly infested with this organism (from poor waters, dung-forced kitchen garden produce, flies, and so forth). Lyon mentions 83 instances of giardiasis occuring in the practices of 8 physicians in or near Philadelphia, all reported within a brief period. However, no mention is made of how suspected specimens of duodenal aspirates or feces were studied. It is quite possible that unless the duodenal aspirates were examined for protozoa, *warm and immediately after their being secured*, some less hardy protozoal forms, whose recognition demands more exact discrimination than does the large and striking giardia, escaped recording. Our experience teaches that, simple though the diagnosis of giardia may be to those familiar with alimentary tract protozoa, mistakes are not infrequently made as, for instance, with queer arrangements of various vegetable cells or moulds (from food) in which waving "flagella" and "parasite movement" are readily mimicked by oscillation or by fluid currents. I have learned by stern experience that parasite recognition and description, as done by lay laboratory technicians, must be supervised by one with special training in protozoölogy.

Material Studied. This report analyses 37 instances where protozoa were secured at biliary-tract drainage, following metapyloric stimulation (?) of the duodenum and biliary tract by warm, 33 per cent aqueous solutions of magnesium sulphate. I have included also one instance where drainage returns of material quite definitely coming from the gall tract, contained viable *Necator Americanus*. That the protozoa to be listed actually came from the bile passages or the gall bladder or both will be commented upon. Each parasite

or cyst was classified according to standard nomenclature (Wenyon,[7] Dobell and O'Connor[8] and Fantham, Stephens and Theobald[9]).

Methods of Observation. The specimens were studied with high-power microscope, upon a warmed stage, within a few moments after their being secured from patients. As in previous papers,[10, 11] I wish to emphasize the necessity for immediate microscopy of duodenal aspirates if one is to be sure that correct descriptions of all protozoa or other organisms contained in the material at hand are returned. Further, the search should be continued just so long as a patient is "draining." If this procedure is not routinely followed, many untrue "negatives" will be listed or but one organism reported, when, upon repeated scrutiny of many smears or hanging drops, multiple infestations would have been observed. "Cold material," however diligently studied, gives no adequate conception of what fresh aspirates exhibit from the standpoints not only of protozoa, but of cellular elements, bacteria or crystalline sediments. Failure to appreciate the importance of examination of fresh material is responsible for the wide differences between the microscopic findings in biliary-tract specimens among workers, particularly with respect to protozoal incidence.

The 37 instances of protozoiasis occurred in the gall-tract aspirates from 1591 patients (2.5 per cent). This is not a low percentage, and those patients whose biliary tracts harbored parasites were definitely and, possibly, characteristically ill; frequently the illness was wholly of the "bilious" form of dyspepsia. In a recent study[11] of stools from 3780 patients, chiefly temperate zone residents, I recorded the finding of protozoa in 265 (7 per cent); 12.5 per cent of these "positive" patients simultaneously carried protozoa seemingly in their gall bladders and bile passages. When the figures are thus analyzed, certainly biliary tract protozoiasis becomes of sufficient frequency to warrant consideration, both as a factor in causing faulty digestion, and as a constant source of recurrences of enteric disturbance.

Necator Americanus in Biliary-tract Drainage Fractions. Since I have but once observed *Necator americanus* in association with biliary-tract parasite incidence, it appears proper to summarize the case here.

From a patient (see Table I), at the fourth attempt to "drain" his biliary tract and after a seven-hour session with frequent intraduodenal stimulation with warm $MgSO_4$ solution, my associate, Dr. R. B. Oleson, recovered quite suddenly, approximately 2 drams of foul-odored, greenish-gray, grumous pus. This came from the tube under pressure. Microscopic examination was made immediately. In one field were seven, viable hookworms (*Necator americanus*) and in others, several ova. The small quantity of bile admixture containing the hookworms was so unlike that obtained at three previous drainages (or that for about seven hours during the fourth,

productive drainage), and the purulent bile was so suddenly delivered that it seemed probable that the unusual specimen came from the gall bladder. At no time, at early or subsequent sessions, did we recover the hookworm from the stomach or ordinary duodenal contents. At several later drainages, but only following the use of magnesium sulphate solutions, the organism was obtained in a manner similar to that of its first recovery and always associated with the parasites or their ova, was a sediment similar to that commonly demonstrable when gall bladder and bile ducts are diseased: that is, bile-stained epithelium in plaques, pigment, cholesterin, pus and a bacterial flora richer than is native to the rapidly emptying duodenum and jejunum. Viable hookworms and ova were later recovered from stools after saline catharsis.

I am not familiar with any literature containing an earlier record of *Necator americanus* having been obtained upon duodenal, bile-tract drainage and particularly any report where proof is strong that the hookworm has found the gall bladder a suitable habitat. The significance of this observation with regard to hookworm carriers and relapses, following seemingly adequate therapy for the *intestinal* affection, needs no emphasis. It is of interest to note that the patient from whom we secured the parasite had travelled extensively in tropical countries some twenty years previous to coming under our observation. We obtained a history of a long-forgotten "dysentery" while in Brazil. At our examination, he had a moderate anemia, with 20 per cent eosinophilia. The patient sought relief from a two-year disability: a "bilious dyspepsia" and an obstinate "rheumatism" of his right shoulder joint. He had served long terms in three Chicago hospitals as a "rheumatic," without relief. Ridding him of his hookworms was followed by prompt restoration to health.

Evidence that Protozoa Secured by Metapyloric Intubation Came from the Biliary Tract. This is not the place to discuss whether or not duodenal drainage, as sponsored by Lyon, is or is not a dependable procedure for securing bile tract fractions. The arguments advanced against the maneuver have been well answered by Lyon[12] and such careful observers as T. McCrae,[13] Silverman,[14] Sachs[15] and McClure,[16] Mann[17] and Whitaker and Boyden.[18] The results of more than 5000 duodenal, biliary-tract drainages under the direction of Dr. R. B. Oleson and myself, have abundantly supported Lyon's views.

While many substances applied abruptly and transiently to the duodenal mucosa appear to act like magnesium sulphate in expelling the gall bladder and bile duct contents. We have found none acting so dependably and vigorously. Furthermore, if one plans to study duodenal aspirates microscopically, the task is more accurately and conveniently performed if the material is "contaminated" with saline fluid rather than by oils, acids, peptone solutions, partly split food, etc. Since the most important facts concerned with

duodenal aspiration are those revealed by microscopic examination, as a diluent and a "stimulus" combined, magnesium sulphate solutions serve admirably when one is searching for protozoa.

Failure to find protozoa in the mouths, stomachs, duodena and upper jejuna of the patients under discussion *previous* to metapyloric instillation of magnesium sulphate solutions and the demonstration of parasites *following* such constitutes strong evidence that the various bile admixtures in which we found protozoa came from the gall bladder and bile ducts. Often the organisms were bile-stained and entangled in characteristic biliary-tract mucus, plaques of duct epithelial cells or in pigment and crystalline sediments. In the presence of such observations, there can exist no reasonable explanation other than that the parasites had been lodged for some time in some segments of the gall tract. Further, although such lumen dwellers as the flagellates and the tissue-invading endamœbæ, theoretically, may travel cephalad from the cecum and small gut by "swimming against the stream," yet it is common knowledge that, even in instances of massive bowel infestation with most active vegetative protozoa, at autopsy or at operation, rarely, indeed, are the parasites demonstrated proximal to the ileum. Acid secretion pouring from the stomach into the duodenum is accepted as a sufficient deterrent to protozoal growth. It has been held that the vigorous peristaltic activity of the proximal small intestine quickly forces caudad with the chyle, even most active flagellates. It would appear that those parasites which we have recovered have invaded the gall tract chiefly when, as vegetative forms, they have been present in swallowed foods or drink or, during a sluggishness of intestinal persistalsis, they have migrated to the bile ducts and gall bladder, I am not yet ready to accept the "new" opinion that systemic flagellosis (as has been advanced by Barrow[19] as an etiologic factor in the production of "rheumatism") is possible through blood or lymph streams. Were such true, one might hold that biliary-tract protozoiasis resulted from excretion of the organisms with bile. It seems that once in the stagnant alkaline bile, protozoa find optimum conditions for living. The possibility of mature hookworm larvæ or the young worms themselves migrating, or being carried by abnormal peristaltic motion from the jejunum and duodenum into the bile passages and gall bladder, is conceivable.[20]

Finally, although the stools of the majority of our patients contained protozoa or their cysts, with the stomach and duodenal residues free from these, in 8 instances of cholecystectomy (*vide infra*), the same (and, occasionally other) parasites found preoperatively at biliary tract drainage *per duodenum* and in the stools, were isolated from the fresh gall-bladder bile.

Therefore, we, maintain that the protozoa which we are reporting as having been found in various gall-tract fractions of bile, were organisms which actually had been resident there, and were not

accidental contaminations of duodenal contents by protozoa which had wandered from gut segments cephalad to the upper jejunum. We believe that these protozoa represented local biliary tract colonizations maintained, in great part, independent of the colonies of like organisms in the intestinal tract. Until evidence to the contrary is presented, we believe that these gall bladder and bile duct colonies interfere with normal function and that, even though the enteric protozoal infestation be eradicated, the biliary tract infestation furnishes a *locus* from which recurrences of the intestinal affection may arise. There is evidence that biliary-tract protozoiasis is accompanied by local tissue injury and that this injury is followed by disturbed secretory or mechanical function.

Species of Protozoa Exhibited at Biliary-tract Drainage. The protozoa were identified in the following frequency: Chilomastix mesneli, 25; Endamœba histolytica, 12; trichomonas, 6; Endamœba coli and giardia each 2.

Single infestations were: chilomastix, 16; Endomœba histolytica, 5; trichomonas, 3; giardia 2.

The following frequency of concomitant infestation was noted: Chilomastix and Endamœba histolytica, 6; trichomonas and Endamœba histolytica, 2; trichomonas, Endamœba histolytica and chilomastix, 1; trichomonas and Endamœba coli, 1; chilomastix and Endamœba coli, 1. Giardia were never observed in association with the other protozoa.

Developmental Stage of Protozoa. Vegetative, motile chilomastix were recorded in 18 instances; chilomastix cysts in 9; vegetative Endamœba histolytica in 10; encysted Endamœba histolytica in 6; vegetative trichomonas in 6 (no encysted forms); vegetative giardiæ in 2. Table I details the frequency with which vegetative and encysted stages of the protozoa were observed.

Comment. In my recent communication[11] on the frequency of enteric protozoiasis in the stools of temperate zone patients, Chilomastix mesneli was found present in 35 per cent, trichomonas in 30 per cent and Endamœba histolytica in 16 per cent. In the duodenal aspirates chilomastix is also most frequently found (68 per cent); Endamœba histolytica occurs more commonly (30 per cent) than does trichomonas (1.8 per cent), even though, in stools of our temperate zone patients, the incidence of endamœba is but a third that of trichomonas.

We offer no explanation why one species of protozoan finds passage into the bile ducts easier than another. Chilomastix mesneli is smaller and a more rapid traveller than either trichomonas or giardia. It may be that it passes the papilla of Vater, ascends the common bile duct and passes through the tortuous cystic duct more readily than does its larger, less agile relatives. Its cysts may be carried cephalad from the gut by reverse peristaltic surgings of contents, by ciliary activity or both. Endamœba histolytica, not

being altogether a lumen dweller, may advance up the gall tract directly on the mucosa, in which event ciliary action may be an aid to vegetative organisms or even to cysts. It is likely that, on occasions, its presence in the gall tract represents a systemic invasion by endamœba (carried systematically from colon *loci*), and then the protozoan is excreted with bile.

Gastric Acidity and Biliary-tract Protozoiasis. Our observations seem to indicate that the harmful influence gastric acidity on the viability of flagellates has been overemphasized. In a previous contribution,[21] I reported gastric trichomoniasis in two patients whose acid secretions were approximately normal and, more recently,[11] have shown that massive enteric flagellosis is possible in the presence of high free hydrochloric acid. Vegetative, but, particularly, encysted forms of flagellates, undoubtedly, pass uninjured through the normal emptying and secreting stomach, especially when mixed with food. It may be that Chilomastix mesneli is more resistant to hydrochloric acid than is trichomonas or giardia. However, such "resistance" may be apparent, not real: at the vegetative stage, the more rapidly moving chilomastix may remain a shorter time in the acid-gastric contents than other less vigorously motile flagellates. Hence, more of the vegetative forms of chilomastix will reach the duodenum—either in chyle or as cephalad wanderers from the small gut. Providing direct migration is possible, a greater number may travel hepatad in the bile ducts. I am well aware that flagellates at their vegetative stage have been regarded as dwellers in only the terminal ileum, but the recent (unpublished) studies upon peristalsis by Alvarez[22] would seem to indicate that many of our concepts of types of large and small gut movement will have to be revised. Certainly, by motion pictures, Alvarez has shown that oscillatory surgings of the gut are common. and that, normally, one may have "reverse" waves. Such might easily carry intestinal protozoa cephalad. Vegetative endamœba of all species are said to exhibit but slight resistance to free hydrochloric acid.

In this connection, the gastric secretory values in the present series of patients are interesting. Test-meal analyses were made in 33 of the 37 cases. To an Ewald meal, there were gastric achylia in 7, diminished acid (below 30) in 23, and normal quantity in 7. Thus, it is evident that approximately three-fourths of our patients were definitely deficient in the theoretical "normal" acid values of their stomach juices. Generally, then, acidity may be assumed to be handicap to protozoic existence but absent or very low gastric acidity is not requisite. The total acidity of gastric contents for the series averaged 26.

It is interesting to note that of the 12 patients from whom we recovered Endamœba histolytica (singly or with other protozoa), in but 4 was there gastric achylia. There were no Endamœba his-

tolytica where the acidity exceeded 38; the free average acid value in the group was, approximately, 12. This is in rather striking contrast to the acid values when vegetative Endamœba histolytica inhabits the bowel. Our series of enteric endamœbiasis[11] exhibited gastric achylia in 82 per cent. This frequent association of achylia gastrica and active enteric endamœbiasis would appear to be dependent largely upon the tendency of vegetative endamœba to locate in bowel ulcers, feed there and thus become a factor in the causation of the resultant anemia: with the occurrence of anemia, invariably gastric acid values fall. As we shall show, only rarely does cholecystodochitic endamœbiasis result in extensive ulcer production along the gall ducts or in the gall bladder; hence, anemia is not often pronounced and gastric acidity, while reduced below normal, is only occasionally absent. The gall bladder ailment is a local one and extensive destructive changes, accompanied by free bleeding, do not occur. It has been shown repeatedly that encysted endamœbæ may pass uninjured through the normally secreting and emptying stomach.

Age and Sex. There were 17 males and 20 females. The average age of males was forty years, of females forty-three or a series average of 41.5 years. The youngest patient was a boy aged eight, and the oldest, a woman, aged sixty-six years. The boy had lived for three years in a small river town in Missouri; the woman had spent her life in rural Northern Illinois. Both patients gave histories of having drunk water from shallow, dug wells or surface streams and both were "garden truck" eaters.

Residence. Eighteen of our patients had spent the earlier years of all of their lives in southern regions, below the "Mason and Dixon" line. There were 20 patients whose permanent homes were in rural sections of the middle of the country. Of these, 14 had, on one or more occasions, sojourned in tropic or subtropic regions, one patient—a woman—had served in the front line, Russian trenches in the World War. Five in this group had had dysentery ("bloody flux" in 3) while in the tropics. Five had experienced diarrhea or "biliousness" in their northern homes within several months of returning from warm climates.

Elsewhere,[23] I have called attention to the observation that Northerners who, when in southern lands, acquire an acute, massive enteric protozoic infestation (even by the so-called, "nonpathogenic" flagellates as chilomastix and trichomonas), appear to respond to it by definite alimentary tract dysfunction or systemic, constitutional symptoms. Similar infestations may be carried by Southern "natives," even from birth, with little or no disability. It is this apparent harmlessness of certain flagellates to the acclimated or "immune" native population which has led to the opinion that such protozoa are incapable of causing any ailment in man, generally. Close study of the "immune" natives, however, usually reveals

that they are not wholly normal:[24] digestive secretions are deficient, the blood is "thin," "bilious dyspepsia" is common and seasonal (spring and fall) transient looseness of the bowels has become part of the routine of life. Even if such folk act as "carriers" only, they cannot be said to be completely "immune;" certainly, as "carriers," they are not to be disregarded as a source of infestation to northern visitors, particularly when the sanitary equipments in the rural communities or small towns in which they reside are ancient or inadequate. This difference in response to intestinal infestations, generally, between inhabitants of warm regions and recently arrived aliens is a well-substantiated observation. (Castellani.[25]) Perhaps not sufficient stress has been given to the possibilities of "immune" natives of subtropic states being so serious a menace to protozoa-free northern transients. We have records of several patients who, during winter vacations, have lived but a few weeks in parts of Mexico, Cuba or Florida where water supplies were "suspicious" and who early experienced "indigestion" after arriving in these southlands. The "indigestion" is usually attributed to changes in diet. It persists, however, progresses to gassy distention of the bowels with loose stools or even diarrhea. When these people return to their northern homes, flagellates or endamœba are present in their stools or gall-tract extracts, and dyspepsia is only terminated when the bowels and bile passages are freed, and kept free, from parasites. Five of the patients in this series dated their "biliousness" or "colitis" from sojourns in warm climates.

Duration of Protozoal Infestation. So far as we could estimate from the histories, former laboratory reports or physical examinations, the duration of protozoal alimentary tract infestation in the 18 southern "immunes" averaged approximately nineteen years. The formation cannot be exact: some of the patients doubtless became "carriers" in childhood. More definite data are available with respect to Northerners. The average duration of enteric infestation was approximately seven years. There were 6 patients where infestation occurred within two years.

Duration of Dyspepsia. The duration of "dyspepsia" attributable to biliary-tract invasion by protozoa ("biliousness"—so often styled), for the Southerners averaged seven and a half years, Thus, it would appear that the "immune" Southerner may carry protozoa in his bowel for an average of more than eleven and a half years before biliary-tract lodgment occurs. Even when protozoa have entered the gall bladder and ducts, the dysfunction develops slowly and symptoms are so mild as to permit more than seven years to pass before relief becomes desirable or necessary. In Northerners, "nonimmune," a short term, massive enteric protozoiasis progresses to a biliary-tract type of affection in approximately a third the time that it does in Southerners; the resultant gall-tract disturbance brings the patient for relief in less than half the time than it does the "protozoa-resistant" Southerner.

TABLE I.—CLINICAL AND LABORATORY DATA IN ASSOCIATION WITH PARASITES RECOVERED PER DUODENAL DRAINAGE.

Case No. Age. Sex.	Chief residence.	Duration and type of ailment.	Nature of symptoms and signs.	Blood study.	Protozoa in stools.	Protozoa in gall-tract drainage.	Duration and result of treatment
A3007 Female 34	Borne and reared in rural Virginia and then lived many years in rural Kentucky	15 years; intermittent abdominal discomfort for 10 years prior to present; 5 years of fairly constant dyspepsia	"Severe abdominal cramps" and diarrhea 13 years ago when in Virginia; appendix later removed, no relief; treated long periods for "colitis;" at present "sore" bowels, gassy bloating, anorexia and easily fatigued; no weight loss; no diarrheic attacks but stools periodically (spring and fall) loose, gassy and of disagreeable odor; irregular nausea; gastric acidity: free HCl, 7; total, 40	Eosins. 3.5%; R.B.C. 3,600,000; Hg. 70%; Leuks. 7400	Stools exhibited many vegetative forms of chilomastix and occasional sluggishly motile Endamœba histolytica	Third drainage exhibited vegetative chilomastix in common duct and gall-bladder fractions; in gall-bladder fraction alone typical cysts of Endamœba histolytica	Under observation 8 years; after first recovery, protozoa disappeared from gall-tract drainages in 3 long-continued sessions; one year elapsed and chilomastix were seen in stools and gall-tract fractions; after 2 more years chilomastix again recovered in vegetative form; last record (1/24/25) patient in good health.
A2289 Male 48	Born and reared in South; lived greater part of life in Texas and Arkansas; spent many years in lumber camps	2½ years; intermittent attacks, generally in spring and fall	Abdominal soreness; "mushy" foul stools; abdominal distention; easily tired; underweight; weight loss varies 5 to 10 pounds in attacks; periodic prostrating diarrhea with foamy, semi-fluid stools; no gross blood; no nausea or vomiting; gastric acidity: free HCl., 0; total, 24	Eosins. 5.5%; R.B.C. 3,800,000; Hg. 65%; Leuks. 7000	Many vegetative forms of Endamœba histolytica, trichomonas and chilomastix	Third drainage bile apparently from gall bladder vegetative trichomonas and chilomastix; at fifth drainage few of these organisms and in addition, moderate number of sluggishly motile Endamœba histolytica	Under observation 8 years; all gall tract and colon protozoa disappeared after 7 drainages; recurrence after 2, 3 and 5 years; at last recurrence only trichomonas observed in gall-tract returns; well 5/9/26.
A4641 Male 56	Lived in Georgia 7 years; early life in Arkansas; last 30 years in Chicago	15 years; formerly periodic but for 3 years fairly constant	Headaches; weakness; "nervous;" "gassy" type of dyspepsia; irregular bowel movements; weight loss 15 to 20 pounds in 2 years; constipation with irregularly recurring periods of frequent and unformed stools; nausea at intervals during past 3 years; gastric acidity: free HCl, 11; total, 27	Eosins. 1%; R.B.C. 4,250,000; Hg. 70%; Leuks. 16,460	Many vegetative forms of chilomastix; cysts of Endamœba coli (Roentgen ray shows ulcerative colitis)	At third drainage vegetative chilomastix and Endamœba coli (cysts)	Cholecystectomy exhibited dilated common duct and large, chronic infectious gall bladder with fundus diverticulum; gall bladder contents contained chilomastix (vegetative) and mucosa was congested and edematous.
A4625 Male 38	Born in rural Italy; lived many years in Florida, California, Texas; resided in Chicago 15 years	12 years; constant for 1 year, intermittent previously	Formerly "bilious" type of dyspepsia; past 3 years periodic duodenal ulcer syndrome and "bowel discomfort;" weight loss 5 to 7 pounds in past 6 months; "dysentery" in Texas; normal motions now but stools frequently "gassy;" (Roentgen ray of colon reveals ulcerated diverticula); no nausea or vomiting; gastric acidity: free HCl, 41; total, 61	Eosins. 6%; R.B.C. 5,080,000; Hg. 80%; Leuks. 8450	Many trichomonas in vegetative stage	At third drainage many viable chilomastix	After fourth drainage no protozoa in biliary-tract extracts (colon infestation cleared up); in 1924 chilomastix again in gall-tract aspirates but disappeared after 2 drainages; observation on 12/3/26, no biliary or alimentary-tract protozoa.

total, 61

A4611 Male 22	Lived for 20 years in north central Mexico; travelled extensively in Mexico; in Chicago 1 year	3 to 4 years; constant for 3 years	Several malarial seizures in youth; not well since—headaches, easily tired, sluggish, mentally; anorexia; general abdominal discomfort; very costive for years; nausea and vomiting irregularly; gastric acidity: free HCl, 8; total, 32	Eosins. 7%; R.B.C. 3,790,000; Hg. 65%; Leuks. 8750	Vegetative and active Endamœba histolytica	No protozoa at first drainage 10 days later, very actively motile Endamœba histolytica seemingly in gall-bladder fraction	Not treated; went abroad to study and "for his health" and "change of climate."
A4598 Female 29	Born and reared in rural Northern Kentucky; was in So. California for 1½ years	8 years; intermittent for first 6 years, constant since	Blood dysentery on and off for 7 years; now attacks with 25 to 30 daily motions; weakness, headaches, exhaustion; weight loss 20 pounds (2 years); alternating periods of severe diarrhea and loose stools of moderate frequency; nausea pronounced in diarrheic periods; vomits occasionally; gastric acidity: free HCl, 32; total, 44	Eosins. 8%; R.B.C. 3,160,000; Hg. 60%; Leuks. 8400	Numerous vegetative Endamœba histolytica and swarms of actively motile chilomastix	On second drainage, encysted Endamœba histolytica and many active chilomastix	Duration of treatment 4 years; initial treatment freed colon of protozoa; 9 months following patient again had viable Endamœba histolytica and chilomastix in stools and encysted Endamœba histolytica in gall-tract drainage associated with chilomastix; cholecystectomy was advised; the removed gall bladder revealed encysted Endamœba histolytica and viable chilomastix; there were numerous shallow ragged ulcers in gall bladder mucosa.
A3803 Male 8	Lived for several years in rural community in Missouri valley; water from shallow dug well	2½ years; intermittent at long intervals	In attacks, headaches, moderate fever, nausea, vomiting, prostration, abdominal soreness and frequent foamy stools; fails to gain weight, growth and strength; bradycardia in attacks; weight loss about 10 pounds below normal; diarrhea of several days' duration in attacks; frequent foamy stools with pungent odor; nausea and vomiting marked in attacks; free HCl, 22; total, 48	Eosins. 2.5%; R.B.C. 4,300,000; Hg. 60%; Leuks. 8800	More than 30 stools carefully examined over 1 year; time failed to exhibit protozoa	At first drainage swarms of actively motile chilomastix seemingly in gall-bladder fraction	Under observation 2 years; gall-tract drainages every third day; after third session no protozoa; protozoa again after 2 months but disappeared after 6 drainages; again seen after 4 months but cleared up in 2 drainages; after 1½ years negative, and lad is now in excellent health.
A3606 Male 45	Canadian by birth but, as construction engineer lived periods in Cuba, South America, Central America, Alabama, Georgia and other states of the U. S. A.	Dyspepsia 3 to 4 years; present disability 1 year; irregularly recurring "biliousness"	Comes mainly for disabling "rheumatism" of ankles, back wrists and knees; irregular abdominal soreness; weight loss 10 pounds (1 year); when in tropical or subtropical region has had "native dysentery" and has passed some bloody stools; treatment and removal to cool climates always stopped disturbance; no nausea or vomiting; gastric acidity: free HCl, 38; total, 70	Eosins. 9%; R.B.C. 4,200,000; Hg. 70%; Leuks. 7000	Several stools exhibited great numbers of vegetative chilomastix and small numbers of vegetative Endamœba histolytica	At fourth gall-tract drainage viable and encysted Endamœba histolytica and great numbers of viable chilomastix	Under observation 6 years; protozoa disappeared after seventh gall-tract drainage; "rheumatism" relieved by routine therapy; 3 years after out-treatment patient operated upon in emergency for acute empyema of gall bladder with necrosis; vegetative Endamœba histolytica in gall-bladder bile.

TABLE I.—CLINICAL AND LABORATORY DATA IN ASSOCIATION WITH PARASITES RECOVERED PER DUODENAL DRAINAGE.—(*Con.*)

Case No. Sex. Age.	Chief residence.	Duration and type of ailment.	Nature of symptoms and signs.	Blood study.	Protozoa in stools.	Protozoa in gall-tract drainage.	Duration and result of treatment.
A5867 Male 39	Always lived in rural Illinois	6 years; intermittent frequent "attacks" more frequent in summer	Headache, vertigo, "gassy" abdominal distention; unusual weakness; weight loss 5 to 10 pounds loss in attacks; "mushy" stools but of normal frequency; no nausea or vomiting; gastric acidity: free HCl, 10; total, 19	Eosins. 6.5%; R.B.C. 3,840,000; Hg. 65%; Leuks. 6900	No protozoa on diligent and repeated search	Enormous numbers of very active chilomastix	Duration of treatment 2 years; 2 gall-tract drainages, few protozoa in last gall-tract fraction; apparently well.
A5864 Male 63	Born near Cincinnati Ohio, has travelled in South	15 years; fairly constant "bilious" type of dyspepsia but recent "acute attack" with moderate fever and slight icterus — called "walking typhoid"	Prostration recently with abdominal distention; formerly "gassy" dyspepsia and some discomfort at right rib edge; "bad breath;" weight loss 18 pounds in 3 months; irregular diarrhea, "without cause," of a day to a fortnight's duration; nausea and vomiting (past three months); gastric acidity: free HCl, 22; total, 36	Eosins. 5%; R.B.C. 4,100,000; Hg. 70%; Leuks. 11,500	Roentgen ray revealed ragged colon ulcers	Encysted Endamœba histolytica and occasional slightly motile forms	Duration of treatment 1 year; operation —ulcerated, chronic cholecystitis and dilated common and hepatic ducts; liver studded with whitish, cystic areas (0.5 to 1 cm. in diameter) not malignant, and no endamœba in them (old, healed small amœbic liver abscesses(?)); no recurrences.
A5743 Female 57	Lived in rural Illinois but spent several winters in California and the South	4 years; constant	Chronic "sore tongue" but worse in spring and fall; weakness, pallor; hemorrhoids; "colitis;" no weight loss; "gassy" stools either infrequently or diarrheic; no nausea or vomiting; gastric acidity: free HCl, 0; total, 3	Eosins. 2%; R.B.C. 4,200,000; Hg. 70%; Leuks. 10,850	Second stool rich in vegetative chilomastix	Third gall-tract drainage revealed many vegetative chilomastix	Duration of treatment 2¼ years; no protozoa in biliary tract after fifth drainage and protozoa disappeared from stools in 4 months (including "relapse"); blood now normal, and glossitis absent after fourth gall-tract drainage; patient subjectively well and refuses further observation.
A5721 Female 51	Lived in northern Kentucky most of life but travelled in Africa, Egypt and southern Europe extensively	10 years; formerly periodic; constant for several years	"Gassy" abdominal distention; headaches; "putty"-like stools; weakness; no weight loss; very costive but occasionally soft motions of putty color; no nausea or vomiting; gastric acidity: free HCl, 19; total, 21	Eosins. 1%; R.B.C. 3,650,000; Hg. 80%; Leuks. 4250	Endamœba histolytica in third stool specimen; Roentgen ray revealed colon ulcers	Second biliary tract drainage, many viable chilomastix	Duration of treatment 2½ years; after recurrence of gall-tract disturbance and colitis the gall bladder was removed; the fresh bile contained encysted Endamœba histolytica and vegetative chilomastix; "strawberry" gall bladder with superficial erosions; no recurrence of gall-tract or stool protozoa since operation.
A5807 Female 45	Early life in Missouri but past 16 years on Idaho ranch; drinking water poor	10 years; intermittent	"Bilious attacks" irregularly with much abdominal distention and irregular bowels; gained 40 pounds in 3 years; when at ranch in warm weather, loose stools of foul odor; well when at home in city; no nausea or vomiting; gastric acidity: free HCl, 6; total, 18	Eosins. 1%; R.B.C. 4,400,000; Hg. 80%; Leuks. 9800	Stools exhibited many vegetative chilomastix	After first drainage, numerous vegetative chilomastix, seemingly from gall-bladder fraction	Came in for diagnosis only; have no reports relative to progress.

A2203 Female 39	Born and reared in northern Illinois; taught school and travelled in Porto Rico for 11 years; invalided home (severe malaria; sprue)	16 years; fairly constant but with periods of prostrating severity	Severe dysentery in Porto Rico called accompaniment of sprue; more recently bloated abdomen; large volume stools, weight loss, *sore tongue* and *gums;* salivation; pallor and weakness; took Ashford's "anti-serum" for sprue; 20 pound weight loss past 3 years; markedly costive but stools of great volume; irregular periods of loose, foamy stools; irregular nausea; occasional vomiting of foamy mucus; gastric acidity: free HCl, 24; total, 66	Eosins. 7.5%; R.B.C. 2,928,000; Hg. 60%; Leuks. 5200; occasional normoblasts but no macrocytic preponderance	Large foamy stools, rich in viable, vegetative trichomonas and many small, yeast-like bodies (Ashford's monilia?)	At fourth drainage great numbers of viable vegetative Endamœba histolytica.	Under observation 11 years; gall-tract drainage in "sprue" relapse, anemia and glossitis, 4 years ago; all protozoa disappeared after 3 drainages and 2 months afterward none in stool; no protozoa observed for 3 years; patient busy and well (8/9/26).
A4632 Male 33	Born and reared in central Texas and travelled extensively in Texas and gulf states; water supply usually dubious	7 years; intermittent until 3 years ago; constant since	"Early attacks of biliousness;" appendix removed, no relief; "floating" kidney anchored, no relief; now constantly sore "bowels" (colon?); mucus in stools; gassy bloating; weakness; weight loss 15 pounds past 6 months; markedly constipated but at rare intervals, large mushy foul stools; irregular nausea	Eosins. 5%; R.B.C. 3,600,000; Hg. 70%; Leuks. 9000	Citrated stools show many viable, vegetative forms of Endamœba histolytica and chilomastix; Roentgen ray reveals ulcerations in sigmoid and descending colon	At second drainage many vegetative chilomastix and few sluggishly motile Endamœba histolytica	Under observation 5½ years; after fourth gall-tract drainage patient free from biliary-tract protozoa and in 3 weeks no colon organisms; 2½ years after first seen colon protozoa again seen; cholecystectomy performed: chronic ulcerative cholecystitis and chilomastix recovered from bile along with encysted Endamœba histolytica; patient well and gain 28 pounds (May, 1926).
B8349 Female 35	Born and reared in middle west, U. S. A., but visited Africa, Italy and Spain 3 years ago	1½ years; intermittent at first; constant 1 year	Eructations; abdominal soreness; pyrosis; colics in lower abdomen; anorexia; insomnia; weight loss 15 pounds past year; been costive all life; worse past 2 years; irregular nausea; gastric acidity: free HCl, 15; total, 30	Eosins. 1%; R.B.C. 4,200,000; Hg. 70%; Leuks. 6650	No protozoa in citrated stools	Great number of trichomonas in vegetative form in what appeared to be gall-bladder bile fraction only	Duration of treatment 2½ months; still under treatment; no protozoa in biliary tract after second drainage; patient improving.
A5483 Male 56	Born and lived until young manhood in Chicago, then spent 13 years travelling; been in S. America, China, India, Africa and much in southern U. S. A.; "had bloody flux" in Brazil 25 years ago	1 to 2 years; constant	Recent "sore eye," but for about 2 years "sore" right shoulder joint, called and treated for "neuritis" in several hospitals; can scarcely move right arm now; dyspnea on exertion; no weight loss; occasionally "gassy" unformed stools of bad odor; no nausea or vomiting; gastric acidity: free HCl, 12; total, 23	Eosins. 23%; R.B.C. 3,700,000; Hg. 70%; Leuks. 9000	Stools exhibited many viable Necator americanus and occasional ova; numerous vegetative forms of trichomonas	At the fourth drainage, sudden expulsion of few cubic centimeters of bile (gall-bladder fraction?) containing numerous Necator americanus	Duration of treatment 2½ years; after third therapeutic drainage no hookworms; 2 months afterward, ova and larvæ again observed; 1 year later few ova and larvæ; none present now (November, 1926); patient subjectively well; larvæ and ova occasionally seen in stools at 4 to 8 months' intervals.
B8394 Male 55	Iowa (China 1898–1900)	28 years; intermittent	Gassy dyspepsia; irregular bowel movements; intermittent glycosuria; no weight loss; very costive but in 1898 in China had "dysentery;" irregularly but pronounced nausea or vomiting on heavy eating; gastric acidity: free HCl, 15; total, 36	Eosins. 1%; R.B.C. 4,740,000; Hg. 95%; Leuks. 7650	Chilomastix (vegetative)	Endamœba histolytica (cysts)	Duration of treatment; irregularly 28 years; recent case (6 weeks); 1 recurrence.

TABLE I.—CLINICAL AND LABORATORY DATA IN ASSOCIATION WITH PARASITES RECOVERED PER DUODENAL DRAINAGE.—(*Con.*)

Case No. Sex. Age.	Chief residence.	Duration and type of ailment.	Nature of symptoms and signs.	Blood study.	Protozoa in stools.	Protozoa in gall-tract drainage.	Duration and result of treatment.
B8379 Female 32	Southern Russia	9 to 10 years; constant since "typhus fever" in 1917	Abdominal pain; distention and pain over colon; cicatricial stricture descending colon; weight loss 25 pounds in 2 years; during World War in army in Russia "typhus"(?); had "dysentery;" recently nausea prominent; gastric acidity: free HCl, 0; total, 6	Eosins. 2%; R.B.C. 4,820,000; Hg. 90%; Leuks. 5510	Trichomonas (vegetative)	Trichomonas (vegetative)	Duration of treatment 8 years (3 abdominal operations); recent case (9 weeks); 1 recurrence.
B8374 Female 40	Illinois (in California 1½ yrs. ago)	3 years; constant	Gall-tract region soreness; bowel distention; weight loss 10 pounds in 2 years; very costive; no nausea or vomiting; gastric acidity: free HCl, 10; total, 16	Eosins. 1%; R.B.C. 4,530,000; Hg. 85%; Leuks. 6350	None	Chilomastix (vegetative)	Duration of treatment 2½ years (1 abdominal operation); recurrent case (7 weeks); 1 recurrence.
B8036 Female 52	Illinois last 10 years, previously rural Russia	Approximately 20 years, but aggravated past 2 years; intermittent	Gall-tract region soreness; sometimes severe pain; occasional slight icterus; weight loss 14 pounds in 3 years; normal stools; occasional nausea; gastric acidity: free HCl, 18; total, 26	Eosins. 1%; R.B.C. 3,800,000; Hg. 75%; Leuks. 9700	None	Many vegetative chilomastix and cysts (after third drainage)	Duration of treatment 1½ years; 2 recurrences; no biliary-tract protozoa for 1½ years; patient subjectively well.
B7901 Female 66	Kansas and Texas, but has been in Orient, Egypt and southern Europe	8 to 10 years; intermittent	Came for tumor (Ca) of left breast and "gassy" dyspepsia; weight loss 17 pounds (6 months); irregular attacks of diarrhea alternating with constipation; nausea irregularly; gastric acidity: free HCl 6; total, 14	Eosins. 4%; R.B.C. 4,100,000; Hg. 70%; Leuks. 7900	Chilomastix (vegetative)	Chilomastix (vegetative and cysts)	Duration of treatment 14 months; 1 recurrence; no biliary tract or intestinal protozoa for 8 months.
B7846 Female 47	Central Indiana, but has been to southern U. S. A. several times	12 years; intermittent	Lower left abdominal pain; irregular bowel movements, bloating and "biliousness;" loses 5 to 10 pounds in attacks then gains rapidly; attacks of diarrhea frequent during past 3 years; nausea irregularly; gastric acidity: free HCl, 4; total, 10	Eosins. 6%; R.B.C. 4,200,000; Hg. 75%; Leuks. 11,000	Vegetative Endamœba histolytica; Roentgen ray revealed open colon ulcers	Encysted and vegetative Endamœba histolytica and vegetative chilomastix	Duration of treatment 2 years; 3 recurrences; no biliary-tract protozoa for 1½ years.
B7765 Female 49	Rural Michigan on truck farm but lived in New Orleans as girl	11 years; intermittent until 3 years ago; constant since 1923	Weakness, headaches, abdominal bloating, anorexia; weight loss 18 pounds (2 years); usually very costive but occasional "mushy" stools; nausea prominent and vomiting irregularly; gastric acidity: free HCl, 0; total, 4	Eosins. 3.5%; R.B.C. 3,860,000; Hg. 70%; Leuks. 6050	Chilomastix (vegetative)	Chilomastix (vegetative and cysts)	Duration of treatment 2½ years; 3 recurrences; no biliary protozoa for 2 years.

B6012 Female 47	Iowa and rural Illinois; has visited southern U. S. A.	5 years; intermittent until 2 years since	Gall-tract region distress; loose stools, headache, weakness; no weight loss; unaccountable looseness of stools irregularly; nausea at intervals; gastric acidity: free HCl, 0; total, 5	Eosins. 1%; R.B.C. 4,120,000; Hg. 75%; Leuks. 9560	Chilomastix (vegetative)	Chilomastix (vegetative and cysts)	Duration of treatment 3 years; no biliary-tract protozoa after third drainage; no recurrence.
A5865 Male 58	Rural and southern Illinois; has been in southern U. S. A.	7 years; intermittent and infrequent until 3 years ago	Bloody diarrhea at periods; abdominal pain; "biliousness;" weakness; weight loss 31 pounds (3 years); normal stools alternating with frequent bloody and painful stools; no nausea or vomiting; gastric acidity: free HCl, 8; total, 20	Eosins. 5%; R.B.C. 3,200,000; Hg. 65%; Leuks. 9300	Cysts of Endamœba histolytica numerous; Roentgen ray revealed ragged colon ulcers	Vegetative and encysted Endamœba histolytica	Duration of treatment 1½ years; 1 recurrence; no biliary-tract protozoa after third drainage.
A5838 Female 37	New York, but 1909–1912 Cuba; 1913, Florida; 1914–1923 Continental Europe	18 years; not well since initial "dysentery" in Cuba in 1909; had "jaundice" at that time, was called "malarial"	Weakness, abdominal soreness, anorexia cardiovascular symptoms, dizziness; weight loss 25 pounds (4 years); extreme constipation for 2 years; "dysentery" previously; marked nausea and vomiting; gastric acidity: free HCl, 4; total, 16	Eosins. 3.5%; R.B.C. 4,380,000; Hg. 80%; Leuks. 4600	Great numbers of vegetative chilomastix and some cysts Endamœba histolytica; ragged colon ulcers on Roentgen ray	Chilomastix (vegetative and encysted) and Endamœba histolytica (vegetative)	Duration of treatment 14 months; 1 recurrence; no biliary-tract protozoa after third drainage.
A8193 Male 31	Born and reared in Missouri but never south of St. Joseph, Missouri	2 years; constant with subacute exacerbations	Soreness at right costal margin; headache; icterus(?); weight loss 15 pounds (1 year); normal stools but very costive at exacerbations; no nausea or vomiting; gastric acidity: free HCl, 10; total, 25	Eosins. reached 4%; commonly between "attacks" 1 to 2%; R.B.C. 4,510,000; Hg. 85%; Leuks. 5150	Many chilomastix, vegetative, and few encysted forms	First drainage no protozoa; second to fifth drainages numerous vegetative chilomastix	Duration of treatment 9 months; no biliary-tract protozoa after fourth drainage for 4 months; then a few seen but disappeared after drainage; none for 5 months; stools free.
A5669 Male 15	Lived in rural Illinois except for several months when in Yazoo Valley, Mo.	1 year; constant	"Nervousness," recurrent "crops of boils," headaches, poor endurance; enlarged axillary and inguinal lymph nodes; no weight loss; normal stools; no nausea or vomiting; gastric acidity: free HCl, 22; total, 38	Eosins. 1%; R.B.C. 4,040,000; Hg. 80%; Leuks. 6950	No protozoa on frequent stool examinations	On first gall-tract drainage, enormous numbers of viable chilomastix	Duration of treatment 2¾ years; drainages at four-day intervals; no protozoa after third session; protozoa never observed in stools; no recurrences; recovery apparently complete.
A5631 Female 32	Lived chiefly in northern Kentucky but travelled extensively in northern Africa, Spain, Italy and Greece	3 years; mild constant dyspepsia with severe aggravation at irregular intervals; very severe attacks in Italy after eating of green vegetables against which she was warned	"Biliousness," gassy eructations; abdominal "cramps" especially in early A.M.; no endurance; is well when in her camp in Ontario; weight loss 10 pounds in 8 months; normal frequency of motions but stools often contain mucus and have bad odor; no nausea or vomiting; gastric acidity: free HCl, 19; total, 28	Eosins. 8%; R.B.C. 4,440,000; Hg. 85%; Leuks. 9600	Endamœba histolytica (vegetative) in stools on several examinations; also sluggishly mobile Necator americanus and ova; Roentgen ray revealed colon ulcers	On fourth drainage, encysted forms of Endamœba histolytica	Duration of treatment 3 years; five months after protozoa observed in gall-tract drainage they were discovered again; since that time (2½ years) none observed; stool 1½ years afterward exhibited sluggishly motile Endamœba histolytica but no hookworms; patient subjectively well.

TABLE I.—CLINICAL AND LABORATORY DATA IN ASSOCIATION WITH PARASITES RECOVERED PER DUODENAL DRAINAGE.—(*Con.*)

Case No. Sex. Age.	Chief residence.	Duration and type of ailment.	Nature of symptoms and signs.	Blood study.	Protozoa in stools.	Protozoa in gall-tract drainage.	Duration and result of treatment.
A5427 Female 33	Born and reared in Illinois but spent 2 years nursing in Panama Canal zone; lived 2 years in So. California	5 years; constant but has attacks of increased severity; appendicectomy in Panama followed by no relief	"Sore" under right costal arch; irregularly recurring mild icterus; anorexia; no endurance; lost 6 pounds in past 3 months, very costive; nausea pronounced in attacks; gastric acidity: free HCl, 17; total, 45	Eosins. 2%; R.B.C. 3,790,000; Hg. 70%; Leuks. 8200	No protozoa in stools	At second gall-tract drainage "cystic" bile exhibited many vegetative trichomonas and Endamœba coli	Duration of treatment 3 years; after fourth drainage no protozoa in biliary-tract fractions; no recurrences; patient well when seen 1 year ago.
A5311 Female 50	Lived most of life in Chicago and rural Illinois, but 13 years ago was in Central America and has made several trips to Algiers, Italy and Egypt	9 years; intermittent	General abdominal "soreness;" slightly "bilious;" gassy abdominal distension; has become very nervous and has scant endurance; "rheumatism" of neck muscles; weight loss 5 pounds (1 year); very costive; rare nausea or vomiting; No test meal given	Eosins. 1%; R.B.C. 4,210,000; Hg. 75%; Leuks. 11,400	No protozoa; Roentgen ray revealed marked fibrosis and lumen narrowing with multiple diverticula of descending colon and sigmoid	First gall-tract drainage revealed many vegetative forms of chilomastic in cystic duct fraction	Duration of treatment 3½ years; no protozoa in gall-tract fractions after second drainage; patient well and comfortable when heard from 1½ years ago.
A5442 Male 53	Born and reared and always lived in west central Mississippi	1 to 2 years; constant	Up to 13 years almost constant malaria "chills and fever;" for 1 to 2 years progressive weakness, pallor; soreness in bowel; dypnea on exertion; weight loss 40 pounds in past 8 months; irregular foul gassy stools becoming normal on exhibition of massive doses of calomel; nausea marked for 1 year; gastric acidity: free HCl, 20; total, 32	Eosins. 5%; R.B.C. 3,670,000; Hg. 65%; Leuks. 8800; coagulation time 5½ minutes; no plasmodia	No protozoa in examination of 23 stool specimens over periods of 4 months	Third gall-tract drainage, vegetative forms of trichomonas and Endamœba histolytica	Duration of treatment 8 months; biliary tract free from protozoa after sixth drainage and steady improvement followed; patient returned to Mississippi, had severe nasal hemorrhage and returned to Chicago; trichomonas again in gall-tract drainages but disappeared after second gall-tract drainage and patient rapidly improved; was well in January, 1926.
A5047 Male 28	Born and lived in Illinois except when in Army; 2 years in Texas	3½ years; constant	"Bleeder" as a child; "dysentery" when in army in Texas; 2 years later severe hematemesis, 7 hemorrhages since and had 8 whole-blood transfusions; has been icteric on and off for 1 year—constantly past 3 months; is very weak; spleen enlarged (1 year); weight loss 27 pounds past year; gassy, foul, mushy stools but at normal intervals; occasional nausea and vomiting past 6 months	Eosins. 2%; R.B.C. 1,660,000; Hg. 30%; no nucleated reds; few poikilocytes; no macrocytic preponderance; Leuks. 3700	Many vegetative forms of chilomastix	2 drainages exhibited vegetative chilomastix	Duration of treatment 2 years; constantly ill; laparotomy disclosed toxic hepatitis; chronically infected, enlarged gall bladder (subacute ulcerative type) and advanced splenomegaly; in the gall-bladder contents viable chilomastix were seen; splenectomy was performed; patient died, portal thrombosis, 1½ years after splenectomy and cholecystectomy.

A4810 Female 22	In early life resided in New Orleans and St. Louis; travelled extensively in South; been in Chicago 10 years	5 years; constant for 2 years but aggravated at irregular intervals; appendicectomy 4 years ago, no relief	Epigastric "soreness" soon after meals; gassy abdominal distention; weakness; anorexia; weight loss 12 pounds in past 3 months; very costive stools often unformed and with foul odor; irregular nausea when epigastric soreness pronounced, vomits; gastric acidity: free HCl, 18; total, 36	Eosins. 1%; R.B.C. 4,280,000; Hg. 75%; Leuks. 7200	None	At first drainage many vegetative forms of chilomastix	Duration of treatment 3½ years; no protozoa in biliary-tract drainages after third session; patient had no recurrence and was well when heard of 1 year ago.
A1206 Male 48	Borned and reared in central Wisconsin; last 11 years as foreman of large ranch in north central Mexico; water: dug wells or shallow streams; much fruit and "roughage" eaten	5 years; intermittent formerly, but during past year never up to normal digestively	Many paroxysms of malaria; one severe and followed by persistent icterus when on his way northward to secure advice with regard an operation upon the gall bladder; had been told that he had an infected gall bladder several years previously; at present running septic temperature and had local tender gall bladder region, swelling, palpating liver and spleen; weight loss 10 pounds; recent severe exhausting dysentery; nausea and vomiting since recent icterus (2 weeks); no test meal; "acute" abdomen, and no protozoa in gastric or duodenal extracts or vomitus	R. B. C. 3,200,000; Hg. 60%; Leuks. 32,000	None (more than 20 stools studied)	No biliary-tract drainage	In touch with patient more than 4 years; gall bladder greatly enlarged, distended, adherent to duodenum; cystic duct almost occluded; mucosa: numerous ragged, superficial ulcerations and at fundus, beginning necrosis; hanging drops of gall-bladder contents, microscopically examined within 2 minutes after cholecystectomy, swarmed with viable giardiæ; no recurrences.
A5440 Male 41	Born and reared in Chicago; engaged in "truck farming;" during World War went to Texas and was encamped there for 1½ years; had 3 attacks of severe dysentery	3½ years; intermittent but during "dysentery" phase; for 1 year has been in hospital on account of bloody stools and advanced anemia of obscure type	Severe anemia; formerly diarrheic, bloody stools; weakness; "biliousness;" enlargement of liver and spleen; has had 17 blood transfusions; weight loss 46 pounds (1 year); on entrance normal stools; nausea prominent; gastric acidity: free HCl, 0; total, 14	Eosins. 6.5%; R.B.C. 1,700,000; Leuks. 11,400	Stools contained enormous numbers of viable giardiæ (also blood and pus); colon plates, chronic ulceration of descending colon and sigmoid	All gall-tract fractions revealed many vegetative giardiæ	In touch with patient until April, 1926; well and gained 64 pounds; no dyspepsia and is in very active business; laparotomy, after 3 massive transfusions of whole blood; liver enlarged (chronic toxic hepatitis); gall bladder, thick-walled and distended; spleen 3 times normal size (chronic splenitis); pancreas firm and large; cholecystectomy and splenectomy performed; examination of gall-bladder contents made immediately; thick, gray-green bile, mucoid and of foul odor; hanging drops and smears exhibited swarms of viable giardiæ.
A3390 Female 63	Born and lived in northern Illinois; long sojourn in Florida and southern California and southern Ohio	12 to 15 years; occasional rare attack of "biliousness"	"Gassy" abdominal distention; eructations; mild headache; no weight loss; normal frequency, but stools sometimes very soft and of bad odor; nausea rarely; gastric acidity: free HCl, 0; total, 7	Eosins. 2%; R.B.C. 4,200,000; Hg. 80%; Leuks. 8900	Numerous stools exhibited no protozoa	At second drainage a moderate number of vegetative forms of chilomastix	Under observation 6 years; no chilomastix seen after fourth drainage; dyspepsia disappeared and patient well 2 years ago.

Nature of the Digestive Dysfunction. Table I gives detailed information regarding the duration and general character of the dyspepsia experienced by patients comprising this report. Space permits calling attention only to certain useful facts and summaries.

The malfunction, roughly, was of the nature of a chronic, constant or irregularly intermittent "biliousness," (this term was most frequently employed by Southerners as descriptive of their woes), or as a more or less incapacitating "bowel disorder," commonly spoken of as "colitis." As will be observed, several subjects came for unexplained "weakness;" two appeared for the relief of obstinate glossitis; they were women, and this handicap to free speech and alimentation served to outweight very obvious anemia and gastrointestinal abnormalities.

Of the 37 instances of biliary tract protozoiasis, Table I indicates that a constant dyspepsia had existed for varying numbers of years in 15 (40 per cent). There were 22 patients (60 per cent) in whom the ailment had been an intermittent affair, most commonly, with mild beginnings (at time infestation was secured?), but, recently, frequently recurring disturbances of increasing severity. However, even when dysfunction was periodic, close questioning usually brought out sufficient facts to justify the opinion that over a considerable time the patient had not been up to par, digestively or physically. As with other types of alimentary tract disease, the discomfort experienced during the "attacks" is remembered, and the relatively comfortable interims represent health as excellent as the subject considers he had a right to expect.

Clinical Picture. Briefly, the average clinical picture was that of a middle-aged individual, lacking in endurance (24 cases), who had lost weight (23 cases) or was below the weight normal to age and sex, and who complained of abdominal "soreness" or discomfort (13 cases) or actual pain (6 cases), "gassy" bowel distention (18 cases), periodic nausea (17 cases), vomiting (5 cases), anorexia (9 cases) and headaches (9 cases), which, often enough, were sufficiently annoying to interfere with his work or recreation. The degree of disability varied in individuals, both with respect to attacks in the entire group and in the same subject at different periods. In 10 patients, distress localized at the right rib margin, in the gall bladder and biliary-tract zones, was a prominent symptom. There were 2 instances where "colics," similar to those of cholelithiasis, were noted. Six patients had experienced definite icterus, and 3 were icteric when they appeared for study.

Usually abnormal bowel movements were annoying. It was for their relief that the patient often sought aid; in fact, it was common for him to attribute all his disorders to some vague "poison" arising in the gut. Ten patients were subject to obstinate constipation; 10 gave history of unexplainable diarrhea followed by marked constipation (not medicinally produced); 7 had movements of normal

frequency, but composed of loose, unformed stools ("foamy," "gassy," "watery," "mushy") commonly of odor sufficiently disagreeable to excite comment; 2 patients had constant, chronic diarrhea (15 to 40 daily evacuations); in but 5 subjects were frequency of motions and character of stools stated as "normal."

These facts have certain diagnostic indications: (*a*) Obstinate constipation may occur in hosts harboring "pathogenic" and "nonpathogenic" alimentary tract protozoa; (*b*) in subjects who have been in tropical or subtropical regions or who have lived in rural sections of the middle and central West, normal bowel movement frequency but with loose, unformed, foul stools, should be a clinical hint to eliminate protozoa as an etiologic agent previous to assigning the cause to be "colitis," "nervous" or "intestinal" "indigestion;" (*c*) in patients, where, without assignable cause, diarrheic, foamy stools of unusual odor alternate with stools of stasis type, enteric infestation by protozoa should be regarded as probable until experienced scrutiny of many stools, after a saline (not an oil or "cathartic pill" stimulus) catharsis has proven them absent. In the last type of abnormal bowel function, especially if there be associated recurrent periods of dyspepsia of a "bilious" character, one should make frequent and thorough study of material freshly obtained by metapyloric intubation for what previously have been called "intestinal" protozoa.

Frequency of Protozoa in Biliary-tract Extracts in Relationship to Protozoa in Stools. Of 37 cases, and from whom we secured protozoa at biliary tract drainage, there were 14 instances where the organisms were present in the stools. In 20 patients, protozoa occurred in both stools and biliary tract fractions. In 3 patients different species of protozoa were recovered from stools and biliary tract extracts (see Table I). That these returns are reasonably accurate is due to the fact that when protozoa were found in the biliary tract extracts, invariably we made it a rule to search diligently for organisms in the stools. In some instances as many as 40 stools were examined, particularly in patients who were in hospitals and who were under daily observation.

It is useful to note that in one instance of giardiasis reported (Case A–1206, Table I) more than 20 stools were studied over a period of five weeks and giardiæ were never observed; neither were they observed in vomitus or gastric lavage returns. Reference to the Table I shows that in stools Endamœba histolytica cysts were observed but twice, whereas the vegetative forms were noted in 7 instances. It is important to emphasize that in the gall tract returns by duodenal tube, 14 instances of infestation by Endamœba histolytica exhibited encysted organisms alone in 4, and both vegetative and encysted organisms in 10. This would appear to indicate that encysted Endamœba histolytica may become vegetative within the gall bladder, bile ducts or upper bowel. Where but encysted

forms are recoverable from the biliary tract and vegetative forms are present in the stools, one must consider the possibility of viable cysts passing from the biliary tract into the alimentary canal and there beginning their developmental cycle. Thus, it would seem that in the biliary tract (gall bladder?), encysted protozoa are potent source of reinfestation of the alimentary canal—quite as important as infestive source to the individual as is a "carrier" passing cysts in his stool toward the infesting of others.

Encysted Chilomastix mesneli occurred in but 6 instances of duodenal drainage. Here again, one must consider the biliary passages as foci for reinfestation, inasmuch as development of the vegetative stage seems to take place in the biliary tracts (gall bladder?) as in the case of Endamœba histolytica. It is not possible to say that damage locally to the gall bladder or bile duct mucosa may not result from the presence of these organisms. Trichomonas and giardia occurred in vegetative form.

There is difference of opinion as to whether any of the flagellates are capable of living as anything but lumen dwellers. Evidence submitted by those who contend that the flagellates are "nonpathogenic" is as incomplete as is that submitted by those who are of the opinion that in certain circumstances flagellates may become pathogenic. Recently, Boeck, in a valuable article on giardia in man, shows that the organisms may attach themselves to mucous membranes but do not appear to invade deeply. It is hardly possible that the attachment of great numbers of giardiæ to the mucous membrane allows the epithelium properly to functionate: one would incline to the opinion that this attachment of a viable parasite would result in damage. Our original case of giardiasis (operatively proved—Case 1206) ran a stormy clinical course and at operation the mucous membrane exhibited numerous, ragged, superficial ulcers with beginning necrosis at the fundus of the gall bladder. The bile swarmed with giardiæ, but giardiæ were never found in the intestinal contents. Freund[32] shows that trichomonas may penetrate fairly deeply into colon ulcers and that it may remain viable there. It is likely that there will have to be a revision of opinion regarding the nonpathogenicity of many of the flagellates; in certain circumstances their "harmless" characteristics may become changed in a manner similar to that where Bacillus typhosus infects the alimentary tract for considerable periods before the host has the typhoid syndrome.

Importance of Frequent Gall-tract Drainage. Table I shows that there were 16 instances of biliary-tract drainage where the first attempt failed to reveal parasites. In one instance, a fifth drainage was required before protozoa were seen. Each drainage session averaged longer than five hours and, in a number of instances, the patient was draining as long as seven hours. These facts should emphasize the patience and diligence necessary, before a subject

may be said to be free from biliary tract parasites. Table I also demonstrates how such a flagellate as Chilomastix mesneli appeared rather promptly upon biliary-tract drainage, but later, in the same session, or at subsequent sessions, the flagellate was accompanied by Endamœba histolytica (or other protozoa) in the encysted or vegetative stage. Further, from one to as many as five local, transient stimulations of the duodenal mucosa by magnesium sulphate solutions, at intervals from one-half to one hour are necessary if adequate knowledge concerning the ability of the biliary tract to drain is to be available. It is also requisite to prove by chemical or fluoroscopic control that the duodenal bulb actually lies between the pylorus and the papilla of Vater. Bile containing protozoa, even though it may come from the gall bladder, need not be "dark brown," "greenish," "muddy," etc., as is thought by some writers. Not rarely, during prolonged biliary-tract drainage, somewhat cloudy, but not deeply colored gall tract fractions are secured which evidently came from the gall bladder and, in them, protozoa may be numerous. Even at operation, the gall bladder may contain only somewhat thickened or rather deeply colored bile admixtures and yet exhibit protozoa. If a biliary tract has been under long continued stimulus, if there is no organic stenosis, and if the function of the papilla of Vater is not normal, the concentrative function of the gall bladder may be deficient and its contents will not be dark colored. Failure to recognize that color of bile has relatively little to do with its containing pathologic material leads to many errors in the interpretation of material obtained during gall-tract drainages.

Anemia. In summary, it will be observed from Table I that the hemoglobin averaged 72 per cent, the erythrocytes 3,980,000. The leukocyte average was 8137.

It is of importance to emphasize that the eosinophil ratio frequently was disturbed. The eosinophils averaged 4.1 per cent for the series. The range was from normal to 11 per cent for the instances of protozoiasis; in the case of hookworm infestation the count reached 23 per cent. Table I suggests that *active* gall-tract infestation by Endamœba histolytica, even when there are vegetative protozoa only in the biliary tract and not in the stool, is accompanied by definite eosinophilia. Of interest, also, are those cases of flagellate infestation where mild eosinophilia is present. In this respect, such increase corresponds to that noted in active enteric flagellosis which I reported recently.

Treatment of Nonsurgical Cases. When possible, rest in bed and a fluid high-protein diet were ordered. Nonsurgical biliary-tract drainage was carried forward at long sessions and at from two- to five-day intervals (depending upon the returns of each drainage). Protozoiasis of biliary tract and stools was constantly searched for. After each drainage, the patients were fairly well saturated with

salicylates for twenty-four hours, and arsphenamin injections, intravenously, were given at from three- to eight-day intervals. In obstinate instances of infestation, after the patient had been upon a fat-free diet for three days, 30 to 60 gr. of thymol were administered. Persistent intestinal or biliary-tract flagellosis often required calomel in large doses (5 to 10 gr.); endamœbic infestations, whether of the biliary tract or in the colon, are treated by massive doses of powdered ipecac in enteric coated pill after the procedure suggested by George Dock in 1902. Where there was persistent recurrence of infestation, operative procedures were advised.

Even after the biliary tract and the intestinal canal were freed of protozoa, patients were requested to report every three to six months for further study. The following case summaries represent the result of nonsurgical management:

Cases Illustrating Effects of Nonsurgical Management.

I.—**Endamœba Histolytica.** Miss F., aged thirty-three years, who has lived in Louisville, Ky., all her life but has travelled abroad extensively and in North Africa, had "inflammatory rheumatism" and "dysentery" when in Florence, Italy.

Presenting Complaint. Iregularly recurring "gassy" type of dyspepsia for more than ten years; usually distress follows soon after eating and during night or early morning; occasional nausea, bloating; never vomits; bowel movement daily; has been a great "roughage" eater both at home and when travelling abroad. Water supply at home from dug wells and while abroad has frequently partaken of waters from questionable sources. Pronounced aggravation of dyspepsia accompanied by right upper quadrant pain. Three years ago at Florence, Italy, following steady and abundant ingestion of greens and uncooked vegetables against which friends had warned her, had severe diarrhea. Never icteric but color always sallow. Lost 10 pounds in weight during last year. Tires easily and physical and mental effort both accompanied by headache.

Physical Examination. Flabby musculature, pale mucous surfaces, myocardial weakness with low blood pressure (systolic, 92; diastolic, 60); muscle spasm over anatomic location of gall bladder and bile ducts; rather marked gastric atony; rather general dilatation of entire large bowel.

Laboratory Findings. Urine normal. Gastric analysis: free hydrochloric, 22; total, 36; gastric contents negative for blood. *Stool:* somewhat foamy, pungent odor, unformed, considerable undigested food of all kinds; cysts of Endamœba histolytica (later, vegetative forms); blood in tract. Blood: red blood cells, 4,530,000; hemoglobin, 70 per cent; white blood cells, 8350; differential negative except for eosinophils, 11 per cent. Basal metabolic rate + 11 per cent.

Gall-tract Drainage. Turbid, thick, dark brownish-green bile mixtures obtained very slowly. Microscopically, very rich streptococcal flora, particularly in "gall-bladder" fraction; much desquamated cuboidal epithelium, excess of cholesterin. At third drainage, in addition to previously discovered flora and sediment, sluggishly motile Endamœba histolytica and two cysts were found; at fifth drainage (three weeks after first) characteristically motile endamœba and several cysts.

Result. All vegetative and encysted forms of Endamœba histolytica as well as associated microscopic anomalies disappeared after ninth drainage.

Rechecked during 1924, 1925 and 1926. Negative stool. On two occa-

sions in 1924, old cysts were found in the gall-tract drainage even though stools were negative for cysts or vegetative forms.

II.—**Sprue and Endamœba Histolytica.** *Presenting Complaint.* Miss M., aged thirty-nine years, had recurrent sore tongue; salivation; intermittent attacks of diarrheic, foamy, foul-smelling stools; 20 pounds weight loss; anemia; was easily fatigued and had headaches.

The patient previously taught school in Porto Rico for eleven years; after the sixth year experienced in mild degree the above symptoms and was seen by Dr. B. K. Ashford and pronounced "sprue." Took Ashford's monilia vaccine without especial relief. During last four years in Porto Rico all symptoms became aggravated and patient was sent to United States for examination and treatment. Passed through several clinics without condition being recognized or directly treated or when condition was known no effect followed dietetic, medicinal or specific (?) vaccine therapy. Recently most obstinate constipation but with stools of type above mentioned.

Physical Examination. Undernourished, dehydrated, middle-aged woman; sallow pale skin; very pale mucous surfaces except tongue and pharynx which are edematous, beef red, fissured, stiff, tender to touch and exhibit hyperplasia of papillae and numerous scattered superficial ulcerations; salivation very pronounced; mouth smears negative for monilia or protozoa; thorax negative except for mild left ventricular hypertrophy (blood pressure 168/72). Abdomen—rather striking general distention especially over terminal ileum, cecum and ascending colon which portions are tender to mild palpation; liver palpable, three fingers below rib margin; pronounced tenderness over theoretic gall bladder zone. Rectum: very spastic, fissured anal sphincter, pronounced dilatation of the rectum; reflex normal.

(Patient states that, though she has had taste disturbance since glossitis appeared, her taste is good or unsatisfactory according as tongue is "peeled" or "sore.")

Laboratory Analyses. Blood: Hemoglobin, 65 per cent; red blood cells, 2,928,000; white blood cells, 5334; eosinophils, 6 per cent. Gastric extracts: Free hydrochloric acid, 24; total, 35; negative for blood. Stool (after saline catharsis) foamy, ammoniacal odor, undigested meat and fat; microscopically, very rich bacterial flora (cocci, colon group bacilli), no monilia; frequent pus cells; unsplit fat and meat fibers; few old cysts of Endamœba histolytica; tests for blood. Urine negative. Wassermann negative. Basal metabolic rate (later) +12.

Gall-tract Drainage. (Four years after patient was first seen and during a relapse in which anemia rather suddenly became pronounced, red blood cells numbered 1,890,000; hemoglobin, 40 per cent; white blood cells 4200 and transfusion was required.) Dark, dirty yellow, opaque, viscid duct and gall-bladder fractions with much amorphous sediment; mucous flocculi in excess, large epithelial plaques, numerous pus cells and both motile and vegetative Endamœba histolytica and recent cysts.

Result. Patient was treated by a vitamin-balanced diet, avoiding of "roughage;" calomel, thymol and arsenic (Fowler's solution and later neoarsphenamin intravenously). Until three years ago, general condition fair but recurrences of sore tongue and mouth, and large volume foamy stools. Two and a half years ago another blood transfusion was needed to combat anemia.

Gall-tract drainages instituted slightly more than two years ago. No parasites after three drainages either in gall-tract specimens or in stools. Test drainage two months ago exhibited an occasional pus cell, excess cholesterin and small amount of cuboidal epithelium but no parasites.

III.—**Chilomastix.** Mrs. S., aged fifty-seven years, had travelled frequently in the South.

Presenting Complaint. Burning of tongue only trouble. This has existed a year and a half; has consulted many internists and various cultists without result. Recently tongue was treated by radium with no benefit.

Physical Examination. Overnourished, but flabby, pale sallow woman with numerous vascular nævi over trunk; chronic nasal obstruction; teeth artificial; red, raw-looking, clean, swollen, stiff, tender tongue and congested pharynx; marked salivation; papillae of tongue hyperplastic; numerous small, lateral, roundish ragged-edged tongue ulcers and several rather deep fissures; uvula very large and tremulous; tongue sensation for sweets and heat reduced. Neck, lungs and heart negative. Abdomen: enormous distention of large bowel, particularly right half; liver just felt; spleen not felt; in the gall-bladder region is a large, tender, firm swelling, pressure upon which produced nausea. Rectum: relaxed sphincter and general atony.

Laboratory Findings. Test meal: free hydrochloric, 0; total, 3; many cocci in smear. Tongue smear negative for Vincent's angina, protozoa or yeasts. Stool: light brown, watery, ammoniacal odor, containing mucus and much undigested vegetable matter. Occult blood, trace. Microscopically, pus—very rich flora of cocci and colon type bacilli, numerous spirillæ and field swarming with vegetative Chilomastix mesneli. Blood: hemoglobin, 70 per cent; red blood cells, 3,900,000; white blood cells, 10,850. Lymphocytes, 28 per cent; polymorphonuclears, 63 per cent; eosinophils, 6 per cent. Urine negative. No blood-derived pigment.

Gall-tract Drainage. Sluggish drainage of common duct and gall-tract fraction, but 150 cc. of latter finally secured. It was brownish-black, opaque, mucoid, contained numerous leukocytes, much cholesterin and bile pigment. In the late portion of the gall bladder and the first portion of the hepatic duct bile (the latter bright amber in color) were observed an increased quantity of pus and many actively motile chilomastix.

Result. Gall-tract drainages every second day were instituted, the sessions averaging more than five hours. Dietetically, fat and protein were reduced; the patient was given hydrochloric acid, mouth washes of sodium chlorid and sodium bicarbonate solution and occasionally weak permanganate solution. After the fourth biliary tract drainage, the outflow of bile was free and "classical" fractions were recovered. With the advent of free drainage, protozoa entirely disappeared from the duodenal aspirates. The intestinal chilomastix infestation was attacked by frequent large doses of calomel and by full doses of thymol (60 gr.) following three days of fat-free diet. With the disappearance of biliary-tract stasis and protozoiasis, loose stools ceased, adequate feeding was possible and the glossitis was relieved. By the time the enteric flagellosis disappeared there were no further mouth or alimentary symptoms.

Recheck, after two and a half years, revealed mild hepatitis, slight subinfection through the bile passages, but absence of pus, blood and parasites in the stool and no recurrence of glossitis. On August 26, 1925, the patient reported herself as being well (three years after the first examination) blood count was normal, eosinophils had disappeared. There was no blood-derived pigment in the urine and a weight gain of nearly 20 pounds had been secured.

IV.—**Chilomastix.** Master A. F., aged eight years, raised in Missouri Valley on farm; always drank water from shallow dug well.

Presenting Complaint. "Stomach trouble" during past year: several attacks of abdominal distress characterized by sudden bloating, nausea, vomiting, temperature 101° to 104° F.; no pain. The attacks last several days and during latter part of attack he has prostrating diarrhea; never jaundiced; dyspepsia has resulted in chronic malnutrition.

Physical Examination. Undernourished boy with large adenoids and mouth breather; slight mitral stenosis; low blood pressure (72/50); abdomen greatly distended, especially in right half; liver palpable 2 finger breadths from edge of ribs; spleen negative; definite muscle spasm and tenderness over right upper quadrant.

Laboratory Findings. Urine negative except for indican. Test meal: free hydrochloric acid present. Stool, after catharsis, putrid odor, mucus in excess, occult blood, microscopically, many Gram-positive cocci and Gram-positive bacilli; numerous pus cells. Blood: hemoglobin, 70 per cent; red blood cells, 3,280,000; white blood cells, 7900. Differential: lymphocytes, 62 per cent; polymorphonuclears, 30; eosinophils, 6.5 per cent. Wassermann negative.

Gall-tract Drainage. Prompt free drainage of 300 cc. bright yellow bile, mucus in excess. In 50 cc. of bile delivered rapidly under pressure (gall-bladder fraction ?) "field alive with rapidly motile chilomastix;" numerous budding yeasts and large segments of an unrecognized mould.

Result. Under limited protein and diet and biliary-tract drainages at three-day intervals, liver enlargement vanished and after third drainage, chilomastix was not seen (no vegetative chilomastix ever found in stool but several encysted forms were seen). Patient's dyspeptic attacks never recurred and within six months patient had gained 12 pounds.

Recheck. Three years afterward, revealed a well-nourished school boy of good color, vigorous and without symptoms. Flagellates absent from gall tract and stool and eosinophil percentage less than 1.

End-results following Nonsurgical Regimen. Of the cases treated nonsurgically, 10 experienced, 1 recurrence; after further treatment no further recurrence. Five recent patients are at present under observation. Of the whole series, 60 per cent recurred, some as high as three times. However, at the present writing, with the exception of the recent cases, the patients are in excellent health and free from parasites in the biliary tract or the bowel, at periods varying from one to four and a half years.

Operative Proof that Protozoa May Have Their Habitat in the Gall Bladder and Bile Ducts. In this report we submit 8 cases upon whom, previous to cholecystectomy, protozoa had been found at biliary-tract drainage, even though in not all the cases had protozoa been demonstrated in the stools. Furthermore, as we shall show, the species of protozoa in the freshly removed gall-bladder contents were, in the main, those recoverable preoperatively from biliary-tract drainage fractions. In the face of such evidence, scarcely is it possible to hold that certain species of protozoa cannot exist in the gall bladder and bile ducts and that, by properly carried out metapyloric biliary-tract drainage, true gall-bladder and biliary-tract contents cannot be secured. Writers (Graham,[26] Boeck,[27] and others) who have argued against duodenal stimuli being capable of securing contents from unobstructed bile passages and gall bladders have not been familiar with the procedure, properly managed clinically, or have quoted ancient literature dealing with uncontrolled experiments or unsubstantiated observations. More recently, Whitaker and Boyden[18] have shown that materials introduced into

the duodenum through the duodenal tube will produce free flow from the biliary tract, and McClure[16] has demonstrated that of all stimuli locally introduced into the duodenum, magnesium sulphate solutions promote the greatest degree of hepatic and pancreatic activity. Physiologists, for a long time, held that gall-bladder emptying was solely an "overflow" or "overdistention" phenomenon; but of late, Mann[17] and even more recently Wilkie,[28] have proven that gall-bladder emptying is due decidedly to active muscular contractions of the gall-bladder wall. The mechanism of such muscular contraction has not been worked out adequately by physiologists, but, in the light of recent reports, it would appear that the major facts concerning contrary innervation brought out by Meltzer[29] and earlier by Doyen,[30] are correct. In a previous paper,[31] we called attention to the observation that, due to overdistention or due to disease of the gall-bladder wall, the quantity of nonstriated muscle in the wall of that viscus frequently escaped notice upon histologic examination. Furthermore, we emphasized that overdistention or disease of the gall-bladder wall seriously interfered with the exercise of function of the muscular contractile elements in the gall-bladder wall or disturbed neuromuscular mechanism and prevented adequate gall-bladder contraction and emptying ("physiologic block"). Recently, Wilkie[28] has proven that in the gall bladder of a cat there is quite as much nonstriated muscle as, but distributed over a wider area than, in the wall of the jejunum of a cat, at its upper levels. Apparently, the critics of non-surgical biliary-tract drainage have not familiarized themselves with the admirable summary of the situation as given by Lyon,[12] or with recent advances in physiology.

Patients Coming to Operation. In summary, our surgical patients exhibited the following protozoa in their biliary tracts (details are given in Table II).

Case Abstracts. CASE A–4721.—*Preoperatively.* Stools exhibited Endamœba hystolytica. Gall bladder fractions exhibited Chilomastix mesneli.

Operatively. Fresh gall-bladder contents exhibited encysted Endamœba histolytica and vegetative forms of Chilomastix mesneli.

Pathologically. A "strawberry" gall bladder showing subacute infection, general edema of the mucous membrane and numerous superficial, "cold-sore like" erosions.

CASE A–4632 *Preoperatively.*—Stools exhibited vegetative Endamœba histolytica. Gall-tract drainage: vegetative Endamœba histolytica and vegetative Chilomastix mesneli.

Operatively. Freshly examined gall-bladder contents contained vegetative Chilomastix mesneli and encysted Endamœba histolytica.

Pathologically. Chronic ulcerative cholecystitis of late "strawberry" type; easily bleeding mucosa.

CASE A–4598 *Preoperatively.*—Stools exhibited vegetative Endamœba histolytica and vegetative forms of Chilomastix mesneli. Gall-tract extracts: encysted Endamœba histolytica and vegetative chilomastix.

Operatively. Freshly examined bile contained cysts of Endamœba histolytica and vegetative Chilomastix mesneli.

Pathologically. Cholecystectomy revealed chronically infected, sluggishly emptying gall bladder, whose wall exhibited thickening and edema. The mucous membrane was spotted with small, ragged ulcerations.

CASE A–3606 *Preoperatively.*—Stool exhibited vegetative Endamœba histolytica and vegetative forms of chilomastix. Gall-tract drainages—Endamœba histolytica cysts and vegetative stages of chilomastix.

Operatively. Cholecystectomy. Freshly removed gall-bladder admixtures exhibited pus, streptococci and vegetative forms of Endamœba histolytica; no Chilomastix mesneli.

Pathologically. Acute empyema of gall bladder, with beginning necrosis of mucous membrane and walls at fundus.

CASE A–5047 *Preoperatively.*—Stool exhibited vegetative forms of Chilomastix mesneli. Gall tract drainages: vegetative Chilomastix mesneli.

Operatively. Cholecystectomy. Freshly removed gall-bladder contents swarmed with chilomastix at vegetative stage.

Pathologically. Enlarged, "angry-looking" gall bladder, exhibiting advanced subacute inflammatory changes in the wall and in the mucosa; toxic hepatitis and splenitis.

CASE A–4641 *Preoperatively.*—Stool exhibited vegetative Chilomastix mesneli and Endamœba coli cysts. Gall-tract drainages: vegetative Chilomastix mesneli and Endamœba coli cysts.

Operatively. Freshly examined bile exhibited vegetative forms of chilomastix.

Pathologically. Dilated common bile duct, showing inflammatory thickening and edema of wall. Enlarged, chronically infected gall bladder, at the fundus of which was a diverticulum 2 cm. deep. The mucosa congested and edematous, but without ulceration.

CASE A–1206 *Preoperatively.*—No stool and no biliary-tract drainages; acute upper abdominal emergency.

Operatively. Freshly removed bile, after cholecystectomy, swarmed with viable giardiæ.

Pathologically. Enlarged, distended gall bladder, adherent to the duodenum; cystic duct almost occluded; mucous membrane exhibited numerous ragged, superficial ulcerations, and beginning necrosis of the mucosa at the fundus.

CASE A–5440 *Preoperatively.*—Stools exhibited enormous number of viable giardiæ, together with blood and pus. Gall-tract drainages: all fractions revealed many vegetative forms of giardiæ.

Operatively. Gall bladder contained thick gray-green bile, mucoid and of foul odor. Hanging drops exhibited swarms of viable giardiæ. Cholecystectomy and splenectomy.

Pathologically. Liver enlarged (chronic toxic hepatitis); gall bladder thick-walled and distended; marked, chronic splenitis; interstitial pancreatitis.

Recurrences. Of the 8 cases requiring surgical treatment, after cholecystectomy their ailments disappeared except in 1 instance (Case A–5440). This patient died of anemia a year after operation (cholecystectomy and splenectomy).

Summary. Various protozoa have been recovered during nonsurgical biliary tract drainage upon 37 patients. Some of these are recognized as pathogenic (Endamœba histolytica and giardia). when they occur in intestinal contents.

We report an instance where *Necator americanus* was present in duodenal syphonates.

A procedure for the demonstration of protozoa in duodenal syphonates secured after Lyon's method of "stimulation" is described. Evidence is presented in support of the opinion that the protozoa recovered had had the gall bladder and bile passages as their habitat.

The clinical picture present when protozoa were obtained upon duodenal "drainage" of the biliary tract is detailed by case records.

The secretory and cytologic concomitants of biliary-tract protozoiasis are recorded.

In 8 instances where duodenal syphonates had exhibited protozoa, at cholecystectomy the gall-bladder contents contained protozoa of the species found prior to operation in those syphonates.

The nonsurgical management of biliary tract protozoiasis is discussed. The indications for surgical interference and the effects of such are detailed.

Examination of the removed gall bladders would support the opinion that protozoiasis of the gall bladder and bile passages may be responsible for recognizable lesions and for digestive dysfunction.

In individuals whose alimentary tracts are infested by protozoa, the invasion of the biliary tract by these organisms may be followed not only by local secretory and digestive dysfunction, but by the persistence of foci of reinfestation from whence intestinal recurrences may arise. It would seem that in all instances of intestinal protozoiasis attempt should be directed toward demonstrating the presence or absence of the organisms in the gall bladder and bile passages. The therapeutic and the prognostic aspects of the problem are evident.

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THE PULMONARY SEQUELÆ OF TONSILLECTOMY IN CHILDREN.

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Introduction. Ever since Richardson[15] published his report in 1913, the subject of lung infections, and especially of lung abscess following tonsillectomy has been a prominent one. The subject at once involves specialists in several fields, the rhinolaryngologist, the bronchoscopist, the thoracic surgeon, as well as the internist and pediatrist. While Richardson's paper was the first to be published in America, the French probably had previously recognized this condition without realizing its full significance. Grossard and Kaufmann,[7] in discussing the systemic complications of tonsillectomy, reported 16 cases of pneumonia or bronchitis follow-

ing the operation, including 1 case of Koenig's, a girl, aged sixteen years, who developed a "fetid bronchitis" immediately after tonsillectomy and died one year later of pulmonary tuberculosis. She had never coughed before the operation. One may surmise that this case was a lung abscess. Bassim,[3] in a similar review, mentions a case of abscess of the lung among his cases of pulmonary infection. Since these writings the American and to a lesser extent the French literature has contained many reports on the same subject. Wessler and Schwarz[21] collected 15 cases of abscess of the lungs in children and included 6 cases of post-tonsillectomy lung abscess in their series. It is surprising that the German literature, except for a few references to postoperative lung infections which barely mention tonsillectomy, contains so little mention of this important subject. The answer may lie in the fact that tonsillectomies are much more frequently performed in America than elsewhere.

Types. An attempt will be made in this paper to differentiate the various types of lung infection after tonsillectomy and to describe their pathology, diagnosis and treatment. They fall into three general groups: (1) Pneumonia; (2) lung abscess; (3) aspiration of foreign body.

Mode of Development. There are three possible routes by which an infection might reach the lung: Aspiration, by means of the blood stream and by means of the lymphatics. Obviously, the foreign-body type of infection is the result of aspiration and we shall, therefore, discuss only the etiology of pneumonia and abscess. Fetterolf and Fox[6] in their experiments on dogs found infective thrombi and infected lymph nodes surrounding the tonsil some days after tonsillectomy. This series of experiments, though well carried out, is certainly not to be considered as having demonstrated that the thrombi seen in the sections of these tissues are the cause of the lung abscess or pneumonia. Thrombi have never been seen microscopically in the pulmonary arteries which furnish the blood supply to a pneumonia or abscess.

As will be seen later, cases of embolic pneumonia or abscess actually are very uncommon and have a different symptomatology from the more usual cases of aspiration infection. Cutler[5] has produced embolic pneumonia in dogs by causing thrombosis of the jugular vein. He also reported the actual production of lung abscess by this means but this was exceptional. Infection by means of the lymph stream is likewise extremely difficult to demonstrate experimentally and no data are available to show that it is a channel for pulmonary infection. On the other hand, the evidence for the development of pneumonia and abscess by aspiration is overwhelming. The early writers believed this to be the common pathway, because it was the most obvious one. The type of anesthetic, usually ether, was blamed. The suppression of the cough reflex

during deep narcosis is probably a most important factor. Myerson,[13] in bronchoscopic studies of 200 tonsillectomies under general anesthesia, found the cough reflex suppressed, and in 155 cases blood and mucus in varying quantity were found in the tracheobronchial tree. None of these patients, however, developed pulmonary disease. They were all previously normal subjects. Myerson's work demonstrates how readily tissue might be aspirated during tonsillectomy and how lodgment in the bronchi is possible. The influence of position is also a factor, especially when the operation is done under general anesthesia. More cases develop in the upright position than when the patient is supine. Of Moore's[12] 202 collected cases of post-tonsillectomy lung abscess, 39 were performed under local anesthesia in the upright position. Because of this fact, Jackson[9] does not completely anesthetize the larynx, and states: "The bechic reflex is the watch dog of the lungs. Don't drug it unnecessarily."

Motor-driven anesthetics, which have now in most cases been discarded, were accorded a leading place in the etiology of pulmonary abscess by Clendening.[4] The forcing of ether into the pharynx and trachea under high pressure has been condemned and is not in general use. It was formerly an important factor in the development of post-tonsillectomy pulmonary complications. The use of suction, however, has become a necessary part of every operation, and it is now used almost universally. In spite of carefully performed operations and with all known precautions, pulmonary infections still occur. The expression of crypts and attempts at disinfecting the throat at the time of operation are also recommended as prophylaxis; but in Moore's series cases occurred in which this precaution had been taken.

The influence of previous pulmonary disease on the development of post-tonsillectomy pulmonary infections has been stressed by some authors. Since all cases in the series here reported occurred in young individuals who were previously in good health, it seems unlikely that previous pulmonary disease was a factor. In one of the two pneumonias reported there was a history of frequent attacks of bronchitis. Of 15 post-tonsillectomy lung abscesses 2 had had pneumonia in infancy, 1 had had frequent attacks of bronchitis and 1 had had influenza two years prior to tonsillectomy. It is difficult to believe that these illnesses had any bearing on the subsequent pulmonary infection.

Many more tonsillectomies are performed in individuals under fifteen years of age than after that time. The incidence of lung abscess, however, is far greater over fifteen years of age than before when compared to the total number of tonsillectomies performed. It may well be that the relatively greater incidence of lung infection following tonsillectomy in adult life is caused by low-grade forms of pulmonary infection, such as chronic bronchitis

and bronchial asthma. One finds mention of tuberculosis of the lungs in children as being fertile soil for a reinfection by other agents. Simpson and Noah[18] report 2 cases of post-tonsillectomy lung abscess developing eleven and twelve days after tonsillectomy done under local anesthesia in the upright position in subjects who had had apparently healed tuberculosis. They describe the abscess as developing around the site of the previous involved pulmonary tissue. It seems difficult to the writer to interpret these cases as tuberculous. The symptoms described and their course suggest that they were cases of lung abscess which probably had no relation to the healed pulmonary tuberculosis. Porter[14] reports 2 cases of lung abscess in patients who had healed tuberculosis. Since lung abscesses develop more frequently in the upper than in the lower lobes, and since healed tuberculosis occurs frequently in the upper lobe, it seems likely that confusion probably has arisen because of these coincidental findings. The possibility of the lighting up of a tuberculous focus cannot, however, be denied. In countries where tuberculous lung infection is more common, this may occur more frequently.

Needless to say, the time for a tonsillectomy is not during or immediately after an acute tonsillitis when the tonsils are filled with virulent bacteria. One of our cases occurred after a tonsillectomy which had been performed a few days after the subsidence of an attack of acute follicular tonsillitis.

Pathology. The concept of the pathology of pulmonary abscess was first set forth by Wessler,[19] who introduced the term "lung suppuration" rather than a breaking-down pneumonia, abscess, or gangrene. He believed that the lung infection is always first a pneumonia which, because of the virulence and type of the infecting organisms went on to suppuration. Aschner,[1] in examining 10 specimens of pulmonary tissue removed by Lilienthal, found a similarity in the pathologic appearance. He calls the lesion a bronchiectatic abscess. He showed that the usual post-tonsillectomy lung infection begins as a localized lesion of the bronchial wall. The larger bronchioles become somewhat dilated, and from the destructive type of inflammation that results, the smaller bronchioles also dilate and become destroyed and finally lead into an irregular cavity containing pus and necrotic material. These localized dilatations then, when infected, are the beginning of the bronchiectatic abscess. Small thrombi are frequently seen in the veins surrounding the abscess but not in the arteries. This speaks very much against a blood-stream origin of the pulmonary pathology.

Anaërobic organisms probably play a great rôle in producing the inflammatory process which occurs in and behind the aspirated material. They probably determine whether or not a pneumonia, which as we have said is always primary, will resolve or whether it will go on to a destructive form of inflammation, namely, abscess

or gangrene. Spirochetes probably play a secondary rôle and only when there has been some breaking down is it likely that the spirochetes invade the lung parenchyma and cause further necrosis. Wessler believes that there is probably a definite time interval between the incubation and growth of the infecting anaërobic bacteria and the breaking down of pulmonary tissue. The eleven- to fourteen-day interval which almost constantly elapses between the tonsillectomy and the beginning of the production of fetid sputum is probably the time necessary for the anaërobes to produce a slough. The type of infection is such that this apparently takes the same time in practically every instance. Conversely, in the ordinary post-tonsillectomy pneumonia of short or long duration we are probably not dealing with anaërobic organisms and resolution takes place as in the ordinary pneumonia. In the case of foreign-body aspiration during tonsillectomy the pathogenesis of lung infection is not unlike that which occurs in lung abscess without aspiration of foreign body. This is especially true of organic foreign bodies. The exact manner in which foreign bodies produce lung abscess has been described by Jackson[8] and others. There is a blockage of the normal secretion of the section of the lung in which the foreign body has lodged itself and a pneumonitis is set up. Then, depending upon whether an anaërobic infection ensues, there is resolution or a breaking down. If the foreign body is removed before breaking down has occurred, resolution will also take place, even though an organic foreign body has been present.

Symptoms. *Post-tonsillectomy Pneumonia.* The post-tonsillectomy pneumonia is like the ordinary ether pneumonia. It is generally ushered in by fever which occurs from twenty-four to forty-eight hours after the tonsillectomy. The first postoperative day is usually afebrile. Together with fever there is profuse perspiration, often at night, and a hacking cough.

There is at first no sputum, but after a few days there is usually a green and yellow secretion which may be blood streaked or of prune-juice color, as in the typical lobar pneumonia. A child with pneumonia does not develop fetid sputum or a fetid breath. Children frequently swallow their sputum, but if there is pulmonary suppuration present the breath will nevertheless be foul. The usual odor of the post-tonsillectomy throat should not be mistaken for the odor of a beginning pulmonary suppuration. The foul, sweetish odor of lung suppuration is usually readily distinguished from the odor of membrane or dried blood which is always present in the post-tonsillectomy throat. Contrary to the onset of lobar pneumonia or lung abscess in adults, one infrequently elicits a history of chill. This holds true for all types of pneumonia in children in which the convulsion as a rule replaces the chill. Pain in the chest is sometimes seen in the post-tonsillectomy pneumonia, but it occurs more constantly in the cases of abscess.

The onset of the post-tonsillectomy pneumonia may vary from the usual type just described. The following case began with a convulsion.

Case Reports. CASE 1.—J. A., aged nine years, was admitted to the hospital on April 15, 1927. Her chief complaint was high fever and convulsions of two hours' duration. The child had had a tonsillectomy performed under ether anesthesia at this hospital on the previous day, April 14, and was sent home the next morning with a temperature of 99° F. apparently well. Eight hours later she suddenly developed a temperature of 106.8° F. She had a convulsion lasting five minutes. When admitted to the hospital at 11 P.M., or about thirty-six hours after tonsillectomy, she was acutely ill, drowsy, and somewhat confused. Her respirations were slightly accelerated. Her throat showed the usual post-tonsillectomy appearance. There was slight dullness and a few râles at the left lower axilla. The pulse was 160.

A diagnosis of post-tonsillectomy infection, possibly a pneumonia was made. There was no cough on admission. The following morning the patient was coughing. A roentgenogram showed a left lower lobe pneumonia. The temperature of 106° F. continued for thirty-six hours after admission when it fell abruptly to normal, where it remained until she was discharged. The morning after admission there was definite bronchial breathing and dullness at the left lower lobe. A roentgenogram taken three days later still showed a pneumonic shadow. Her lung signs largely cleared up and a roentgenogram taken shortly after discharge was entirely negative. A follow-up roentgenogram taken in August, 1927, four months after her discharge, was also negative.

This case is an example of the early and rapid development and progress of a post-tonsillectomy pneumonia. The complete duration was thirty-six hours. The physical signs and Roentgen ray evidence confirmed the diagnosis of pneumonia. This type of infection probably occurs frequently after tonsillectomy and is often considered to be merely a postoperative rise in fever. It seems probable that were these cases examined and roentgenographed more frequently, more pneumonias of short duration would be discovered.

The following case represents the more usual type of post-tonsillectomy pneumonia.

CASE 2.—C. M., aged nine and a half years, was admitted to the hospital on May 20, 1927. He had had a tonsillectomy under ether anesthesia at this hospital ten days before admission. He was kept in the hospital over night and went home the following morning with a normal temperature. He was well for six days at home, when he vomited and began to cough sanguinopurulent sputum and had a temperature of 105° F. He had tarry stools, evidently due to oozing from the tonsillar fossæ.

He was acutely ill and had typical signs of a right upper lobe pneumonia. The hemoglobin on admission was 45 per cent. The leukocytes were 16,000 with 97 per cent polymorphonuclears. His admission temperature was 104° F. The admission blood culture was negative. The roentgenogram confirmed the physical findings of a right upper lobe pneumonia.

The fever remained constantly between 104° and 105° F. for five days, when it fell by crisis to 96° F. The hemoglobin fell to 42 per cent. The child made an uneventful recovery and on June 14 the chest roentgenogram was negative.

This case then was a pneumonia beginning six days after tonsillectomy, running a severe course of nine days with typical signs and sputum of a pneumonia and ending in crisis.

Whether this pneumonia was the usual postoperative ether pneumonia or whether it was a separate infection is debatable. It seems probable, however, that the tonsillectomy had a causal relation to its development. In neither of the foregoing cases was there any evidence of pulmonary necrosis.

Lung Abscess. The lung abscess cases have a different symptomatology. Fever and sometimes pain in the chest are the first signs. The fever is sometimes of the septic type, although it is more likely to be continuous with slight remissions. It is often as high as 104° F. Cough begins in a few days. It is short and hacking, has a rasping quality and is persistent. These symptoms last usually for ten days without cessation. On the tenth to fourteenth day after operation the sputum becomes foul or if the sputum is swallowed the breath becomes fetid. Once fetid sputum is present, one is certain that a destructive inflammatory process due to anaërobic organisms has taken place and that pulmonary necrosis is established. The exact day of onset of the fetid sputum is in our series not as constant as it is usually stated. This may be because of the difficulty in obtaining an accurate history which is also due in part to the fact that the child swallows sputum or coughs only slightly for several days.

The following are the case histories of 15 post-tonsillectomy lung abscesses in children admitted to Mount Sinai Hospital from 1921 to 1927.

Case 3.—L. S., aged seven years, was admitted, October 20, 1921. She had had measles and diphtheria one year previously. One month before admission the child had a tonsillectomy done under ether anesthesia. One week later the child developed cough, fever and foul-smelling sputum. The temperature ranged from 102° to 103° F.

Physical examination revealed an acutely ill child, breathing rapidly. The breath was foul. There was dullness and diminished breathing over the lower part of the right lung with numerous crackling râles throughout the whole right lung. The hemoglobin was 65 per cent. Bronchoscopy on November 2 showed pus coming from all the right lower lobe branches. The temperature ranged between 99° and 104° F. during the child's stay in the hospital. The sputum became more profuse. The child's general condition became worse. Roentgenogram on October 20 showed a dense pneumonic infiltration occupying the right lower lobe. No abscess cavity was seen on the film. Operation on November 3 disclosed a large gangrenous abscess occupying nearly half of the right lower lobe. In spite of transfusion the child did not respond and died ten hours after the operation.

Autopsy revealed a right lower lobe lung abscess, an interlobar empyema and an acute terminal bronchopneumonia.

CASES OF POST-TONSILLECTOMY LUNG ABSCESS, 1921–1927.

Case No.	Name.	Year.	Age.	Lobe of lung.	First symptoms.				Day of onset P. O.	Treatment.	Course and result to date.
					Fever.	Cough.	Sputum.	Chest pain.			
1	L. S.	1921	7	R. L.	+	+	+	−	8	Exploratory thoracotomy and drainage	Rapidly progressive, 7 weeks, ceased P. O. shock, acute terminal bronchopneumonia. Autopsy.
2	J. G.	1921	10	L. U.	−	+	−	−	*	Medical	Spontaneous recovery, 6 months, well.‡
3	F. B.	1921	10	R. U.	−	+	Foul +	−	*	Medical	Spontaneous recovery, 2 months, well.
4	C. M.	1921	12	R. U. & R. L.	−	+	+	−	*	Medical	Spontaneous recovery, 10 weeks, probably well.
5	J. B.	1922	11	L. U. & L. L.	+	+	−	+	*	Bronchoscopy, exploratory thoracotomy and drainage	Fairly satisfactory, bronchiectatic cavities still present.
6	G. W.	1922	6	L. U. & L. L.	+	+	Foul and bloody +	+	14	Bronchoscopy, lobectomy	Progressive, ceased P. O. hemorrhage. Autopsy.
7	S. D.	1922	9	R. U.	+	−	−	+	14	Medical	Spontaneous recovery 5 weeks, well.
8	N. E.	1923	5	R. L.	+	−	Foul +	−	11	Exploratory thoracotomy and drainage	Closure of bronchial fistula, 9 months, well.
9	C. A.	1923	10	R. U.	+	−	Foul +	+	8	First admission, medical; second admission, medical; third admission, operation, thoracotomy	Progressive, ceased March 30, 1924 following unsatisfactory medical treatment. Multiple pulmonary abscesses, bronchiectasis, terminal bronchopneumonia. Autopsy.
10	M. M.	1923	8	R. U. & R. L.	+	+	Foul +	+	*	First admission, exploratory thoracotomy and drainage; second admission, medical	Unsatisfactory, 2 years, ceased pulmonary hemorrhage, 1925. No autopsy.
11	H. G.†	1923	3	L. U.	+	+	−	−	10	Exploratory thoracotomy and drainage	Normal convalescence, 3 months, well.
12	J. P.	1923	5	R. M. ? & R. U.	+	+	Foul +	−	*	Medical	Spontaneous recovery, 2 months, well.
13	E. P.	1924	12	R. U.	+	+	Foul +	+	10	Medical	Spontaneous recovery, 2 months, well.
14	K. U.	1925	4	L. U.	+	−	Foul +	−	*	Medical	Fulminating, ceased, sepsis, multiple pulmonary abscesses, pneumonia, empyema. Autopsy.
15	S. M.	1926	5	L. U.	+	+	Foul +	−	10	First 2 admissions, medical and bronchoscopy; third and fourth admission, thoracotomy and drainage	Medical treatment, unsatisfactory 11 months, still improving under surgical treatment.

Anesthetic used in every case was ether.
Cases 2 and 4 had pneumonia in infancy.
Case 6 had pertussis and influenza in 1920.
Case 11 had frequent attacks of bronchitis in infancy.
All the other cases have no previous pulmonary infection.

* Exact date of onset inaccurate.
† Possibly a case of post-tonsillectomy pneumonia with empyema.
‡ Few healed infiltrations seen on Roentgen ray.
Case No. 8 is reported by permission of Drs. M. H. Baas and H. Neuhof. All others were treated in the Surgical and Pediatric Wards of the hospital.

CASE 4.—J. G., aged ten years, was admitted, September 10, 1921. He had had measles, whooping cough and pneumonia in infancy. Two months before admission a tonsillectomy was performed under ether anesthesia at another hospital. A few days later the child began to cough and to bring up foul-smelling purulent sputum. He had afternoon fever almost daily.

Physical examination showed a chronically ill boy, who had lost weight and whose breath was foul. There was dullness over the left upper lobe anteriorly and breathing over this area was almost cavernous in character with a few fine râles. Posteriorly, there was dullness to the fourth vertebra with bronchial breathing and inconstant râles. The hemoglobin was 76 per cent. The leukocytes were 27,000, of which 76 per cent were polymorphonuclears. Roentgenogram on admission showed a dense shadow occupying nearly the entire left lung, more intense over the upper portion. A definite diagnosis of lung abscess could not be made from this film.

He had temperature ranging from 100 to 101° F. He coughed up as much as 175 cc. of sputum a day. This had been reduced to 15 cc. before discharge. The odor also had disappeared before he was discharged, but the left upper lobe was still dull.

The child was readmitted on December 5, 1921, because of recurring dyspnea and cough. Similar signs to those found on the first admission were again present in the left lung. The hemoglobin was 96 per cent; the leukocyte count was 13,000, of which 69 per cent were polymorphonuclears.

Roentgenogram on December 21 showed an infiltration in the left upper lobe and what appeared to be a number of small cavities suggestive of a bronchiectatic condition. The child coughed up very little sputum and was again discharged improved.

The first roentgenogram did not demonstrate an abscess cavity. On the second admission small multiple cavities appeared which were probably bronchiectatic. He was then not seen until August, 1927. The patient was symptom free and had had no sputum or fever at any time. Physical examination of the lungs was entirely negative. Roentgenogram on August 18, 1927, showed a few coarse infiltrations in the left upper lobe.

We may consider this case then as a spontaneous cure.

CASE 5.—F. B., aged ten years, was admitted, September 24, 1921. She had had measles in infancy. There was no previous pulmonary history. Tonsillectomy had been done under ether anesthesia on August 15, 1921. The patient began to cough on about September 1, fifteen days after tonsillectomy. The cough was at first spasmodic in character. The breath was at first not foul but fetor was noticed a few days later. Her temperature gradually rose and on the day before admission she had a temperature of 104° F.

Physical examination showed dullness at the right apex anteriorly and posteriorly, breathing bronchoamphoric in character with increased fremitus over this region and many moist râles on coughing. The leukocytes were 15,000; the polymorphonuclears, 74 per cent. The sputum was negative for tubercle bacilli.

Bronchoscopy showed pus coming from the right upper lobe branch of the right bronchus. The Pirquet test was negative. A roentgenogram on admission showed an infiltration in the right upper lobe which suggested a lung abscess with a fluid level. The child's temperature at first ranged from 100° to 103° F. for six days. Following that and for the following three weeks, during the remainder of the child's stay in the hospital, there was no fever. The cough and sputum diminished in intensity. The roentgenogram on September 29 showed a decrease in the infiltration of

the right upper lobe. No fluid level was seen on this film. She was entirely well on October 4, when she was discharged.

This then was a case of lung abscess which cleared up spontaneously.

CASE 6.—C. M., aged twelve years, was admitted, November 14, 1921. He had had scarlet fever, whooping cough and pneumonia in childhood. A tonsillectomy, under ether anesthesia, was performed four weeks before admission. He was apparently well for two weeks after the operation except for a slight cough. At that time it became increasingly severe and he expectorated a large amount of foul-smelling sputum.

Physical examination showed dullness, bronchovesicular breathing and moist râles in the right axilla and over the right upper lobe anteriorly. The hemoglobin was 60 per cent. The leukocytes were 15,600, of which 88 per cent were polymorphonuclears. The Pirquet test was negative. Roentgenogram on admission showed a circular cavity about 8 cm. in diameter in the lateral half of the right lower lobe. The child had fever to 102° F. for the first four days while in the hospital and following that was afebrile until he was discharged. The roentgenogram taken on December 21, 1921, showed a complete disappearance of the infiltration of the right lower lobe. He was discharged well on December 28, 1921.

CASE 7.—J. B., aged eleven years, was admitted, April 3, 1922. He had had measles and whooping cough in childhood; no history of previous respiratory disease. Ten months before admission a tonsillectomy was performed under ether anesthesia at another hospital. A few days later he complained of malaise, cough and fever and of pain in the left chest. On the twentieth day (?) after operation he brought up a large amount of foul-smelling sputum. He had intermittent cough and fever and lost weight during the ten months previous to his admission to Mount Sinai Hospital.

Physical examination showed dullness over the left chest anteriorly, distant bronchovesicular breathing; no râles were heard. Posteriorly, the left chest was dull, the breath sounds distant. Fingers and toes showed clubbing. Marked pallor was evident. The leukocytes were 14,000; the polymorphonuclears, 80 per cent; hemoglobin, 60 per cent.

Bronchoscopy under local anesthesia showed the left bronchus filled with very foul-smelling pus. The patient received three bronchoscopic irrigations with iodin solution. Roentgenogram of the chest showed an infiltration involving the left upper lobe with marked pleural thickening over the left lower lobe and diaphragm. Roentgenogram on April 22 showed several small localized collections of air and fluid, suggesting multilocular effusions. The temperature ranged between 99° and 103° F. On May 10 a localized pneumothorax was seen on roentgenogram indicating a perforated lung abscess.

Because of the progressive character of the lung infection, the child was operated on June 1, 1922, and pleural adhesions were separated and several ribs resected. A lung abscess was aspirated and drained. The child was transfused twice, had a severe postoperative course but improved and was discharged with a bronchial fistula six weeks later. The fistula closed in six months.

The child was then not seen until August, 1927. In December, 1925, following a fall, he had a slight pulmonary hemorrhage. His general condition in August, 1927, was good except for occasional cough and sputum at night. He did not have fever or chills.

Physical examination of the chest showed a large operative scar well healed. There was dullness and slightly diminished breathing over the left

upper lobe, no râles being heard. The heart was drawn slightly to the left, probably the result of fibrosis. The fingers were slightly clubbed.

Roentgenogram showed a number of bronchiectatic cavities throughout the upper two-thirds of the left lung, one of which contained some fluid. This case then is still active.

CASE 8.—G. W., aged six years, was admitted, February 3, 1922. He had had influenza and pertussis two years before admission. A tonsillectomy was performed five months previously, under ether anesthesia. After tonsillectomy there were apparently no symptoms for two weeks, when the child began to have a mild dry persistent cough. Two months later, or three months after the tonsillectomy, he had fever, pains in the chest and cough associated with very foul, profuse sputum, occasionally blood streaked.

He was flabby, poorly developed, pale and coughing. Over the left chest anteriorly and in the axilla there was slight dullness with distant bronchial breathing high in the axilla; posteriorly, dullness from the angle of the scapula to the base with diminished breathing and a few râles. The fingers and toes were clubbed. The hemoglobin was 80 per cent; the leukocytes, 18,000, with 83 per cent polymorphonuclears. The Pirquet test was negative. The sputum was negative for tuberculous and elastic tissue. Bronchoscopy on March 23 showed pus coming from the left upper and lower lobe bronchi. He received three bronchoscopic irrigations with iodin solution. He had fever ranging from 100° to 102.6° F. with occasional afebrile days.

Roentgenogram on admission showed a pneumonia of the left lower lobe. No abscess cavities were visible. On February 17 the roentgenogram showed a large abscess in the left upper lobe. It was about 6 cm. in diameter and partly filled with fluid. It was surrounded by a dense infiltration. The child did not improve and at operation the upper lobe was found densely adherent to the chest wall on all sides, three ribs were resected and a week later a large-sized interlobar abscess was drained. Lobectomy of the left upper lobe was done. The child stood the operation well. He died two weeks later following a profuse hemorrhage.

The autopsy showed gangrene and multiple abscesses of the left lower lobe (left upper lobe had been removed), abscesses of right lower lobe and a bronchial fistula of the left lower lobe.

CASE 9.—S. D., aged nine years, was admitted, September 6, 1922. He had had measles at seven years of age. There was no history of previous lung disease. Three weeks previously the child had had a tonsillectomy done under ether anesthesia. About two weeks after the tonsillectomy the child had a temperature of 104° F. and complained of pain in the left chest. The temperature had been between 101° and 104° F. daily for one week.

Physical examination showed a poorly nourished boy, acutely ill. He had dullness, distant bronchial breathing and voice over the right infraclavicular region. His breath was foul. The leukocytes were 24,800; the polymorphonuclears, 70 per cent. Blood culture was negative. A roentgenogram of the chest on September 6, 1922, showed a pneumonic infiltration in the upper part of the right lung. There was no evidence of abscess formation.

On fluoroscopy, September 9, a cavity about 1 cm. in diameter partially filled with fluid was seen in the upper portion of the right chest. Pirquet test was negative. Fluoroscopy, on September 12, showed the cavity to be much less marked. The temperature was 102° to 104° F. during the first two days of hospitalization and fell to normal at the end of a week and

was practically normal until the child was discharged on October 7. The lung signs had disappeared at the time of discharge except for slight dullness over the involved area. The roentgenogram on September 20, 1922, showed an infiltration in the upper part of the right chest.

The child was next seen in August, 1927. He had been entirely well during the past five years. Unfortunately no roentgenogram was obtained, but the child's general condition was excellent and he had no expectoration. The case may be considered well.

CASE 10.—N. E., aged five years, was admitted on December 19, 1923. Her past history was irrelevant. Seven months before admission a tonsillectomy was done under ether anesthesia. Eleven days later she began to have fever and foul expectoration. She became pale and her fingers had become clubbed.

Physical examination showed dullness and diminished breathing over the right lower lobe with numerous râles. A roentgenogram of the chest showed a dense infiltration of the right lower lobe apparently extending to the pleura with some evidence of pleural adhesions. The leukocytes on December 31 were 10,000; the polymorphonuclears, 75 per cent. The hemoglobin was 68 per cent. The child had no fever on admission.

The child was operated upon and a focus containing foul-smelling, broken-down pulmonary tissue was incised and drained. The postoperative course was severe, but with the aid of transfusion the child improved and was discharged with a bronchial fistula, which closed nine months later. It is probable that this child had a lung abscess which had perforated and then had become walled off in the pleural cavity. In September, 1927, nearly four years after the operation, her lungs were negative and a roentgenogram showed only the fibrosis resultant to operation. This case is an operative cure.

CASE 11.—C. A., aged ten years, was admitted, September 5, 1923. She had had measles and diphtheria in infancy. Two months before admission the child had a tonsillectomy under ether anesthesia. One week later she developed pain in the right chest, cough and foul-smelling sputum.

Physical examination showed a poorly developed child acutely ill. She was cyanotic and slightly dyspneic. Her fingers were clubbed. There was dullness and increased fremitus over the right upper lobe with an amphoric quality to the breath sounds in the right axilla. Numerous moist râles were heard over this area. The hemoglobin was 59 per cent and the leukocytes 27,600 with 64 per cent polymorphonuclears. Roentgenogram on admission showed an infiltration in the region of the middle lobe of the right lung with some cavity formation within the infiltration. She had a temperature ranging between 100° and 102° F. for the first five days in the hospital, and after that she was practically afebrile. The pulmonary signs and cough diminished, the odor of the breath was less foul, and she was sent to the country on September 30, 1923.

She was readmitted five weeks later because of an increase in the cough and sputum. The physical signs over the right upper lobe were more marked. Pirquet test was negative. The leukocytes were 13,000 with 74 per cent polymorphonuclears.

The roentgenogram on November 16 showed a dense infiltration in the right lung and a number of cavities in the infiltrated area due to abscess formation. She was discharged improved on December 7, 1923, but did poorly and was admitted for the third time in February, 1924, and a thoracotomy was done; the postoperative course was unsatisfactory and she died on March 30, 1924.

The autopsy showed multiple pulmonary abscesses with bronchiectasis and a terminal bronchopneumonia.

CASE 12.—M. M., aged eight years, was admitted, August 24, 1923. She had had whooping cough, measles, mumps and scarlet fever in childhood. The child had a tonsillectomy performed under ether anesthesia six weeks before admission. About one week later she began to complain of pain in the right chest anteriorly and posteriorly, followed by cough, fever and foul sputum.

Physical examination showed a poorly nourished and developed child acutely ill, cyanosed and breathing rapidly. Her fingers showed beginning clubbing. The right lung was dull anteriorly to the fourth rib and posteriorly over the same area. Fremitus was increased, breath sounds were exaggerated and numerous crepitant and moist râles were heard over that region and throughout the remainder of the right chest. The hemoglobin was 75 per cent; the leukocytes, 25,000, of which 76 per cent were polymorphonuclears.

A roentgenogram on August 25, 1923, showed a dense infiltration of the right upper lobe, in the center of which was a cavity. The child's temperature on admission was between 100° and 101° F. and continued for six weeks. Pirquet test was negative. She coughed up foul-smelling sputum daily.

She became pale, lost weight and on October 24 she was operated upon. Thick pleural adhesions were broken down and several small abscesses were opened and drained. The condition of the child improved so that she was discharged afebrile with her wound still discharging in December, 1923. She did fairly well for a time, then had a return of expectoration and fever. She was operated upon a second time in 1925, and died following a profuse hemorrhage.

CASE 13.—H. G., aged three years, was admitted, July 20, 1923. He had had measles at the age of one year and frequent attacks of bronchitis. The child had a tonsillectomy done under ether anesthesia one month before admission. He had had a mild cough prior to the operation. Ten days after the operation there was an increase in the cough and an irregular fever, which rose to 105° F., began and continued until admission to the hospital.

Physical examination showed a pale boy, acutely ill. There was dullness over the upper part of the left chest anteriorly and posteriorly, bronchial breathing and fine râles. The fingers were clubbed. Pirquet test was negative. The hemoglobin was 65 per cent; the leukocytes were 21,000 with 68 per cent polymorphonuclears.

Roentgenogram on admission showed a thickened pleura with an underlying pneumonic infiltration. The fever ranged between 100° and 102° F. with occasional higher peaks for the first four weeks after admission. Signs of pleural effusion appeared and at operation on August 23, 1923, a well-walled off collection of thick pus was found in the middle of the left pleural cavity. The underlying lung was seen to be infiltrated. There were several pulmonary communications from which pus and air escaped. Convalescence was uneventful and the child was discharged on September 22, 1923.

This case must probably be interpreted as a post-tonsillectomy pneumonia or lung abscess which perforated into the pleura and produced a walled-off empyema.

This patient was next seen in August, 1927. He had been symptom-free since he was discharged. There was slightly diminished breathing over the scar in the left lower axilla. The fingers were slightly clubbed. Roentgenogram of the chest showed no evidence of parenchymatous change. This case then is surgically cured.

CASE 14.—J. P., aged five years, was admitted, August 21, 1923. He had had measles, whooping cough and scarlet fever in infancy. In June, 1923, two months before admission, the child had a tonsillectomy performed under ether anesthesia. He was well for two weeks following the operation, then had fever, cough and blood-streaked foul sputum.

Physical examination showed an acutely ill boy coughing. The breath was foul. There was dull tympany over the right upper chest, prolonged expiration with an amphoric quality and moist râles. The hemoglobin was 75 per cent; the leukocytes were 25,000, of which 65 per cent were polymorphonuclears. Roentgenogram shortly after admission showed a pulmonary infiltration in the region of the right middle lobe but no roentgenographic evidence of lung destruction. The admission temperature was 101° F., subsequently it was normal. The sputum and cough lessened, the lung signs became less marked and the boy was discharged. The roentgenogram at that time showed a decrease in the infiltration in the left lung. Although no abscess was demonstrated on the plate, it is very likely that with the foul sputum, cough and fever either a single abscess or multiple small abscesses which cleared up spontaneously were present.

He was not seen for four years until August, 1927. He had been entirely well. Physical examination was negative. Roentgenogram of the chest showed no evidence of infiltration or abscess.

This case recovered spontaneously.

CASE 15.—E. P., aged twelve years, was admitted, July 9, 1924. She had had measles, and frequent sore throat. Thirteen days before admission the child had a tonsillectomy done under ether anesthesia. Six days after the tonsillectomy the child became feverish, and had sticking pain in the right side of the neck and shoulder region. She began to cough and had a temperature of 101° to 102° F. at first and after a few days the temperature rose to 104° F. About eleven days after the operation she expectorated a foul-smelling, dark-colored sputum.

She was acutely ill, had slight dyspnea and coughed up foul-smelling green-colored sputum. There was dullness, increased fremitus, bronchial breathing, numerous crepitant râles and exaggerated voice and whisper over the upper half of the right chest. The fingers were slightly clubbed. The leukocytes were 45,000, of which 88 per cent were polymorphonuclears. Roentgenogram of the chest on July 10, fourteen days after tonsillectomy, showed a dense pneumonic infiltration involving the entire right upper lobe with a circular cavity about 6 cm. in diameter. Pirquet test was negative. Sputum examination for tuberculosis was negative.

She had irregular fever for five weeks. The child expectorated at first 75 to 125 cc. of sputum daily. This gradually diminished and lost its fetid odor.

On August 6, 1924, the roentgenogram showed absorption of the inflammatory process at the apex and the cavity had nearly disappeared. Clubing of the fingers began to diminish, and on August 21 it was barely noticeable. The child was symptom-free when discharged.

The patient was then not seen until August, 1927. Physical examination of the lungs was entirely negative. There was no clubbing of the fingers. Roentgenogram of the chest was negative. This case then was one of spontaneous healing.

CASE 16.—K. U., aged four years, was admitted, May 9, 1925. He was apparently well before Apri 15, 1925, when a tonsillectomy was done under ether anesthesia at another hospital. Fever of 102° to 104° F. was present immediately thereafter and a cough and purulent expectoration began.

Physical examination showed an acutely ill child breathing rapidly. There was marked dullness over the left upper lobe. The breath sounds over this region were diminished with an amphoric quality. Occasional musical râles were heard. The hemoglobin was 62 per cent; the leukocytes were 51,000, with 80 per cent polymorphonuclears, of which 40 per cent were premature forms. The child was too sick to have a roentgenogram taken. The temperature ranged from 100° to 105° F. There were petechial skin lesions and multiple furuncles, which suggested sepsis, although the blood culture on admission was sterile. Pirquet test was negative.

The child died on the fifth day in the hospital. Postmortem examination showed multiple abscesses of the left lung, a left empyema and an acute lobar pneumonia of the right lower lobe. Smears from the lung abscess and pleural fluid showed Gram-positive chained cocci. This case was probably a sepsis following tonsillectomy in spite of the negative blood culture. The lung abscesses were of the embolic rather than the aspiration type.

Case 17.—S. M., aged five years, was admitted, August 7, 1926. He had had measles in infancy. About three weeks before admission the child had a sore throat with fever to 102° F., which lasted two or three days. Immediately thereafter, a tonsillectomy was advised by a local physician and performed under ether anesthesia. Four days after the operation the child developed a temperature of 105° F. About ten days after the operation cough and foul-smelling sputum began. Fever persisted and the sputum increased. The hemoglobin was 53 per cent; the erythrocytes, 3,900,000; the leukocytes, 25,200, with 70 per cent polymorphonuclears.

Physical examination showed an acutely ill child expectorating fairly large amounts of thin mucopurulent, slightly fetid sputum. There was slight dullness over the left upper lobe with slightly suppressed breathing, and subcrepitant and moist râles. A roentgenogram showed an almost completely filled cavity in the left upper lobe with a surrounding pneumonia. Sputum showed no tubercle bacilli. Pirquet and Mantoux tests were negative. The temperature for the first four days rose to 103° F. and then was below 100° F. for seven weeks. He was kept in the open air day and night. Nourishment was forced. Repeated roentgenograms showed a decrease in the size of the cavity and the pneumonic infiltration. Physical signs were also less marked. On September 22 the abscess cavity had disappeared and the pneumonic infiltration on the roentgenogram was much less marked. The child was sent to the country on September 30, 1926.

About the middle of November he again had cough, fever and pain in the chest and the roentgenogram again showed a dense infiltration in the left lung. Bronchoscopy on December 9 showed pus coming from the left upper lobe bronchus. The bronchus was irrigated. Bronchoscopy was repeated several times, but without benefit. He was again sent to the country but continued to cough and lost weight.

At operation in June, 1927, the pleura was found to be densely adherent and was freed from the chest wall and the lung compressed. He was improved when last seen in December, 1927, but is still under treatment. This then is a case of lung abscess which was treated conservatively for nearly a year with progression in symptoms, and was then operated upon.

Foreign Bodies. The symptomatology of pulmonary infection caused by foreign bodies aspirated during tonsillectomy is unfortunately not sufficiently characteristic to permit an early diagnosis in every instance. The nature and position of the foreign body

determines the character of the symptoms. Foreign bodies may be present for years without causing symptoms and the possibility of the aspiration of a foreign body during a tonsillectomy may have been entirely overlooked because of the time interval.

CASE 18.—H. G., aged twelve years, was admitted, October 6, 1926. Three weeks before admission he had a tonsillectomy and adenoidectomy performed under ether anesthesia at another hospital. He was sent home the following day apparently well. Three days after the tonsillectomy he began to have a dry hacking cough. He had no fever. Seventeen days following the tonsillectomy he first felt listless and feverish. His temperature was 101° F. and increased gradually to 104° F. during the next few days. Twenty days after tonsillectomy he had chest pain for the first time. He had no sputum.

He was acutely ill, temperature of 103° F., pulse and respirations elevated. He was coughing frequently but did not expectorate. His breath was not fetid. He had dullness to flatness and markedly diminished breath sounds over the lower half of his right chest and diminished fremitus over this area. The hemoglobin was 95 per cent; the leukocytes, 36,400, with 82 per cent polymorphonuclears.

A provisional diagnosis of post-tonsillectomy pneumonia with the possibility of a superimposed serous or purulent pleural effusion was made. The roentgenogram taken on October 7 showed a pneumonic infiltration in the right lower lobe, and a shadow close to the hilus which looked like a bicuspid tooth. It was found that one of the boy's bicuspid teeth were missing, and bronchoscopy was therefore performed under local anesthesia on October 8 and the tooth removed. The temperature which had been 101° to 103° F. before bronchoscopy fell to normal, coughing ceased, the signs of atelectasis became less marked and the boy made an uneventful recovery.

He was reëxamined in March, 1927. The lungs showed no abnormal physical signs and the roentgenogram showed complete disappearance of the previous shadows.

The first symptom in this case was the dry, hacking cough. Unlike the other cases of pulmonary disease following tonsillectomy, this patient did not have fever at the onset. He was examined by a physician six days after the operation and was sent to school, his only symptom at that time being an unproductive cough. It was only after seventeen days that he began to feel listless and feverish. His breath was not fetid. In the other cases that we have seen fever had constantly been present as an early sign of lung infection. This is then an important differential point. The foreign body, which in this case fortunately caused a cough, did not set up an infection severe enough to cause fever for seventeen days.

Physical Signs. The physical signs of post-tonsillectomy pneumonia may coincide completely with those of the usual lobar pneumonia of childhood. Anemia, due both to blood lost at the operation and to the supervening pulmonary infection, may be a prominent symptom.

In the abortive type of pneumonia first described there may be very few pulmonary signs. In our case the slight dullness and

fine râles in the axilla which were present were sufficient to make one suspicious of pulmonary involvement. The other pneumonic signs were absent except for the high fever and correspondingly accelerated respiration.

The cases of lung abscess often show a surprising lack of physical signs. The most constant finding is dullness. This is often the only sign of abscess. Râles are often not heard. Breath sounds are usually exaggerated, either vesicular or bronchial. Expiration is prolonged. Fremitus is usually increased. Voice is well transmitted and bronchophony, rarely egophony, may be present. The physical signs are those of an infiltration rather than those of a cavity filled with fluid.

The systemic signs are those of a chronic infection—pallor, perspiration and loss of weight due to anorexia. Clubbed fingers occur almost constantly. They may appear as early as two or three weeks from the onset of cough. They may occur even earlier; occasionally not until the pulmonary breaking down has become well established. Clubbing may disappear as rapidly as it appeared. The cough is often productive, although there may be a time when the abscess cavity or cavities are empty and then the cough is intermittent or nonproductive. There is usually moderate dyspnea. Cyanosis is not marked.

In our series of 15 cases the lobes of the lung were involved as follows: Right upper, 7; right middle, 1?; right lower, 4; left upper, 6; left lower, 2. The preponderance of upper-lobe infection is marked and coincides with the findings of other authors. (See Moore.[12])

The foreign body cases have marked dullness to flatness with markedly diminished breath sounds over the portion of the lung which is the seat of the foreign-body obstruction. Fremitus over this area is usually diminished. In fact, the dullness may be so marked that with the past history of persistent cough one is led to the diagnosis of effusion over an underlying pneumonic process. The signs are, however, due to atelectasis. The breath sounds may not be entirely absent if the bronchus is not completely occluded. There is generally fever with sweating and a moderate degree of sputum which may or may not be foul smelling. The pulse and respirations are elevated proportionately with the fever.

The foreign body in our case was located in the right lower lobe bronchus. This is usually the case in the aspiration of foreign bodies.

Diagnosis. The diagnosis of the post-tonsillectomy pulmonary complications is not always readily made. The differentiation must at first be made between a pneumonic process and a general reaction. One often encounters cases of fever immediately following tonsillectomy. The fever may be due either to a local or a general infection or to any pulmonary complication. Three or four days

may pass before a diagnosis is possible. In the beginning no physical signs are demonstrable. General infections or actual sepsis which may occur following tonsillectomy may simulate by their features a pulmonary involvement. These include accelerated breathing, high fever, cyanosis, perspiration, etc. The differential diagnosis between pneumonia, abscess and foreign body is also not easy. In general the pneumonias are of more abrupt onset and their course is limited. Fetid sputum is absent. The abscess cases are more likely insidious in the beginning with not quite as high fever as in pneumonia and they do not terminate at the end of the tenth day or soon after. The foreign body cases have as their predominating symptom an irritative cough which at the outset is unassociated with fever unless a pneumonia is also present.

The roentgenogram is an invaluable diagnostic aid. If a case in which a foreign body is present is not seen during the first week or two after the aspiration, a pneumonic reaction may have been set up and its shadow may be so dense that the foreign body is obscured. This is less likely in the case of a metallic object. Milk teeth are unfortunately often obscured in the shadow of a pneumonia. Careful study of a film will sometimes demonstrate such a tooth and bronchoscopy is warranted if the symptoms also suggest foreign body.

The use of lipiodol in bronchoscopy has lately come into vogue. It may help to differentiate a pneumonia from an abscess.

The leukocyte count is moderately elevated. In pneumonia the count runs usually from 15,000 to 30,000 leukocytes with 80 to 90 per cent polymorphonuclears. In the abscess cases the count is somewhat lower, usually from 15,000 to 20,000. The leukocyte count, however, is not to be taken as a direct guide, although a mounting leukocyte count when taken daily or every other day with continuation of fever speaks for an empyema following a pneumonia or abscess formation rather than for resolution. A pneumonia, which often surrounds a lung abscess, also causes an increase in the leukocyte count.

Where no physical signs are present a blood culture is advisable to rule out sepsis. Bacteriemia following tonsillectomy has been reported.[16]

The sputum examination may be of value. If there is a bloody or prune-juice sputum with cough soon after tonsillectomy, pneumonia is probably present, although the blood may come from the tonsillar fossæ, whereas with a fetid secretion occurring later a breaking down is taking place. The examination of the sputum for spirals and elastic fibers is also of value in demonstrating destruction of lung tissue.

Bronchoscopy as an aid in the differentiation of obscure pulmonary complications is of inestimable value. Jackson,[8] Yankauer,[22] Lynah[11] and others have written about this subject repeatedly.

The bronchoscope has undoubtedly found its place among real diagnostic aids. Needless to say, the bronchoscope in the hands of a skilled operator is of little danger and may be the means of avoiding unfortunate complications by its prompt use in the removal of foreign bodies.

Course. The abortive pneumonias following a tonsillectomy run a course from thirty-six to forty-eight hours and leave no residuum. These may be so abrupt that a positive diagnosis without Roentgen ray confirmation is questionable.

The more frequent type of pneumonia with high fever runs a course similar to the usual lobar or bronchopneumonia of children. The course may be severe and there may be considerable doubt until crisis or lysis occurs as to the exact termination of the infection. Delayed resolution may occur and it may be weeks before the lungs are clear. In these cases the differentiation between lung abscess and unresolved pneumonia may be difficult and only by the absence of fetid sputum and by roentgenologic findings can one decide in favor of unresolved pneumonia. In this condition low-grade fever may persist for weeks. Occasionally there is a true effusion following the pneumonia which may become purulent, giving a picture which closely simulates abscess formation because of the character of the fever and expectoration and general appearance of the patient.

In the case of lung abscess the course may vary greatly. In Wessler's[20] series 9 out of 26 postoperative lung abscesses recovered spontaneously. Eight of these 9 were post-tonsillectomy cases. A certain number cleared up within a few months with the aid of irrigations through the bronchoscope. Those that do not become well within three or four months at the longest, do not as a rule regress without some other form of treatment. Cessation of sputum does not necessarily mean that the pulmonary disease has cleared up, for a chronic infiltration may be present.

The possible complications include a variety of conditions. A spreading of the infection from the primary abscess by local extension frequently occurs and multiple bronchiectatic cavities are formed. Once many foci of infection are established in the bronchioles, treatment becomes difficult and the course is usually progressive.

Pleurisy as a complication of abscess frequently occurs. A thickening of the pleura takes place since the abscess usually extends out toward the periphery and causes a pleural inflammatory reaction. This is often dense. Similarly, an empyema can develop and occasionally there is a pleurobronchial fistula with a pyopneumothorax. Acute spreading pulmonary gangrene occasionally occurs.

One of the most dangerous complications of post-tonsillectomy lung abscess is hemorrhage, which may prove fatal.

Systemic complications include general toxemia which is usually present throughout the duration of the abscess, and also secondary anemia which may require transfusion. If the lung abscess is long-standing and the patient is bedridden amyloid disease may even develop.

Metastatic abscess, most frequently in the cerebrum, is one of the most feared complications of pulmonary abscess. The extension occurs by means of septic emboli. Fortunately there is no instance of this complication in the series here reported.

The course of the foreign body cases is a variable one. If they are recognized early and the foreign body is removed before there is lung infection the course is a short one; the convalescence rapid with no sequelæ. Only too frequently, however, the foreign bodies, which are often metal parts of the tonsillectomy instruments, do not produce symptoms sufficient to attract attention on the part of the patient or his physician. The metal foreign bodies are usually noninfective and pulmonary infection does not develop. Likewise, the bronchial wall, except for some erosion, is also not the seat of an infectious process and no extension occurs. If, on the other hand, the foreign body is an organic substance, it is likely to cause destruction of pulmonary tissues by its presence and by the infection which it produces. If this type of foreign body has been in the bronchial tree and an infection has developed behind it with the formation of pus, its removal may cause a cessation of the infection. More often if suppuration is established removal does not aid unless followed up by irrigation through the bronchoscope.

Prognosis. Pneumonias, uncomplicated, offer the best prognosis in post-tonsillectomy lung infections. The foreign body cases offer a good prognosis provided the foreign body is removed early.

In this series of 15 lung abscess cases there were 5 deaths. The cause of death in 1 case was probably postoperative shock. The child died ten hours after operation in spite of a transfusion. Postmortem examination showed in addition a bronchopneumonia.

A second death was due to pulmonary hemorrhage occurring soon after a lobectomy. A third death was due to a sudden pulmonary hemorrhage two years after operation. The fourth death followed a thoracotomy after two years of unsatisfactory medical treatment. In the fifth case (Case 16) it is probable that we were dealing with a blood-stream infection following a tonsillectomy in spite of a negative blood culture. Eight cases are well at the present time. Of these, 6 were treated expectantly, 2 were operated upon. Two cases are improved; one after five years still has bronchiectatic cavities in the left upper lobe. One case which did badly under medical treatment for a year was operated upon twice and is improved. All of those that cleared up spontaneously have remained well, there being no recurrences in this series.

Treatment. The treatment of post-tonsillectomy pneumonia is like the treatment of the ordinary pneumonia of childhood. The hemoglobin should be watched closely and if it falls below 40 per cent transfusion must be considered. Recent reports by Bass,[2] Sidbury[17] and others show that transfusion can safely be carried out in pneumonia in children and may be the determining factor in carrying the child through the critical period. Complications should be treated as they arise.

For cases of foreign bodies aspirated following tonsillectomy, the only treatment is immediate bronchoscopic removal. This may be difficult, but in the hands of a skilled operator the discomfort is reduced to a minimum and with patience the foreign body is most often removed at the first attempt. There is no justification for waiting once the diagnosis is established. Fever or physical signs of a pneumonia are certainly not contraindications to bronchoscopy, and they will not subside if a foreign body is present. On the contrary, prompt removal will cause a clearing up of the pneumonia and a cessation of the fever.

The treatment of post-tonsillectomy lung abscess must be considered in three ways: (1) Medical, (2) medical plus bronchoscopy; (3) surgical. It is not within the scope of this paper to discuss all of these in detail but there are definite indications for the use of each. As soon as the diagnosis of lung abscess is established an attempt should be made to aid its evacuation. This is often accomplished by postural drainage.

Surprisingly large amounts of sputum will often be evacuated in this manner. This type of treatment should be repeated at two- or three-hour intervals. Steam inhalations or inhalations of benzoin with steam are often of value in aiding expectoration. Climatic change which appeals to so many for the treatment of chronic cough is of practically no value in the treatment of acute lung abscess. There is some disagreement as to whether bronchoscopic irrigations should always be carried out in cases of lung abscess following tonsillectomy. Statistics on this subject are not available, for the duration of the abscess is too short to compare expectant and bronchoscope treatment in the same case.

Irrigation of the bronchi through the bronchoscope accomplishes practically the same purpose as postural drainage and probably does it better. The irrigating fluid enters the large bronchi and by aid of suction the thick viscid exudate is mechanically removed allowing the entrance of the fluid into the more dependent portions of the lung. This also allows the entrance of air and helps destroy the anaërobic bacteria which are probably present in every lung abscess. With the forced coughing that takes place during bronchoscopy, the infected material is removed by means of suction and reinfection of another portion of the lung is prevented. In postural drainage there is no suction present and the possibility of

autoreinfection must be borne in mind. One always notices a diminution in the fetid odor of the secretion following bronchoscopic irrigation. The irrigating fluids are usually of dilute iodin solution, although acriflavine and other dyes are also used.

In the series here presented 8 cases recovered spontaneously without bronchoscopy. One recovered spontaneously with bronchoscopy. Three did not do well in spite of bronchoscopy and were subsequently operated upon. In spite of the fact that 8 cases recovered without resorting to bronchoscopy, one should not wait too long before resorting to its use if spontaneous improvement does not take place. The likelihood of a medical cure rapidly diminishes when three or four months have elapsed. If a case is not doing well three weeks after onset of symptoms, if fever continues and the child does not look well, bronchoscopy had best be started and continued weekly. It is also possible that an unexpected foreign body may be discovered at bronchoscopy. It also definitely establishes the exact site of the disease process, that is, which lobe or lobes are involved. This knowledge may aid further treatment. Bronchoscopy should be kept up until the secretions have practically ceased and Roentgen ray and clinical evidence point toward healing of the abscess.

The length of time that bronchoscopic treatment should be continued is also a question which cannot be decided dogmatically. There are cases which respond to irrigations and eventually heal without operation. Their number is small, but if there is no evidence that the abscess is spreading, and that new foci have not developed, and the patient does not get an intercurrent infection, it is justifiable in some instances to postpone operation.

The surgical treatment of post-tonsillectomy lung abscess is steadily becoming more satisfactory. Lobectomy, extensively developed through the excellent work of Lilienthal,[10] when successful, establishes a cure. The mortality from this operation is, however, high. Various estimates in the type of case that we are considering place it from 35 to 50 per cent. It is a question whether or not it is justifiable even with this mortality to take the operative risk with the chance for cure. Less radical measures are also not free from a relatively high operative mortality and results from them are not encouraging. A thoracotomy with evacuation of a pulmonary abscess or evacuation of a localized pleural abscess, the result of a breaking through of a lung abscess, yields the best opportunity for cure. The establishment of a bronchial fistula will aid drainage, and if all the diseased tissue is expectorated or drained the fistula will close spontaneously. When there are multiple bronchiectatic abscesses throughout one lung, collapse by pneumothorax may be performed. This is not, however, always possible since there is generally a large amount of pleural thickening, so that collapse of the lung cannot be instituted without resecting some of the pleura.

The type of operation which has probably the best rationale is bronchostomy. It establishes through-and-through drainage and aërates and drains the diseased portions of the lung. The presence of air destroys the anaërobic organisms and promotes healing. The fistula should be continued until there is Roentgen evidence of a clearing up of the pulmonary disease. If the bronchial fistula closes before the lung is entirely free from infection it may require reopening.

The best initial form of treatment for post-tonsillectomy lung abscess then is medical with or without bronchoscopy; if this fails, continuation of bronchoscopy for a time; if both of the foregoing are ineffectual, some form of operation, the individual case often being suited for one type of operation rather than another.

Prophylaxis. A paper on the subject of post-tonsillectomy lung infections would not be complete without a note about prophylaxis. Mouth hygiene should be carried out before any operative procedures are undertaken. Loose or missing teeth should be noted, and any which are likely to become dislodged during the operation had best be removed. Food or liquid should be forbidden for at least eight hours previous to the operation.

With modern operative appliances there is no excuse for the operation being done in any but an approved manner. Strict surgical technique should be carried out as in any major operation. Suction should always be used throughout the operation, and the patient should always be turned to the lateral position as soon as the operation is finished. It may be advisable, if there has been considerable bleeding or secretion in the throat during the operation, to suspend the child's head over the end of the operating-room table so as to empty the tracheo-bronchial tree of any aspirated material or vomitus. Complete hemostasis of not only the tonsillar but also the adenoid areas must be secured before the patient leaves the operating table, for while the patient is being transferred from the operating room to the bedroom blood might be aspirated from these sources.

Exposure immediately after operation is to be avoided and children should be kept in bed for at least twenty-four hours in every case and longer if there is any fever at the end of that time.

Summary. Post-tonsillectomy lung complications include pneumonia, abscess and foreign body. The infections caused by these give a varied symptomatology and prognosis.

A series of 15 post-tonsillectomy lung abscesses is described. The prognosis for spontaneous recovery is fairly good. Death results in the majority of cases that do not recover within three months.

It is to be hoped that with increasing preoperative care and improved technique during the operation, a lowered number of pulmonary complications following tonsillectomy will result.

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REVIEWS.

DENTAL INFECTION AND SYSTEMIC DISEASES. By RUSSELL L. HADEN, M.A., M.D., Professor of Experimental Medicine, University of Kansas School of Medicine, Kansas City, Kansas. With a Foreword by Dr. E. ROSENOW, Mayo Clinic, Rochester, Minn. Pp. 160, 63 illustrations. Philadelphia: Lea & Febiger, 1928. Price, $2.50.

THIS little book is the latest addition of the steadily accumulating literature of the subject brought first prominently to the medical and dental professions, by William Hunter thirty years ago. Its purpose is to supply, by experimental study, some comprehensive investigations of the lesions of dental origin in animals, particularly rabbits, as well as the recital of a number of cases of patients suffering from various diseases of the articulations, gastrointestinal vascular and nervous systems, supposedly of dental infections. Sixty pages cover the latter. We notice the histories in many cases are incomplete. It has been the object of the author to ascertain the results of cultural experimentation with the bacteria derived from these sources, not always with success and convincing results, some instances recorded showing no connection, or only a remote one, between the two. Some of the anatomic terms are now obsolete. Not a few of the pathologic conditions incidentally referred to have been shown in recent years to be incorrect. A dental granuloma, so-called, is considered to-day, to be merely a chronic inflammation of the alveolar periosteum of the teeth and jaws. As a granuloma it is nonexistent.

Like other writers on this subject, the author is inclined to exaggerate, and frequently ascribe a dental origin to a disease, when by further investigation and completer evidences, other causes could be found to be the *fons et origo mali.* H. S.

RECENT ADVANCES IN TROPICAL MEDICINE. By SIR LEONARD ROGERS, C.I.E., M.D., B.S., London School of Tropical Medicine. Pp. 398; 12 illustrations. Philadelphia: P. Blakiston's Son & Co., 1928. Price, $3.50.

THIS is a very valuable contribution to the subject of tropical medicine. The book is arranged so as to include the etiology, pathology, symptomatology and treatment of tropical diseases in

such a brief and yet complete manner, as to make the book of special value to clinicians, for it describes in detail the most modern methods of prophylaxis and treatment of these affections.

Under the discussion of amœbic dysentery it is of interest to notice the description of its complications, with special reference to the inflammation of the cecum and ascending colon, which may closely simulate appendicitis and may lead to useless and dangerous operations by surgeons unfamiliar with the pathology of the disease. It may be said in passing that the author, in the discussion of amœbic dysentery, places too much emphasis on emetine as a specific for the disease. Clinical experience has shown that this drug is only effective in about one-third of the cases.

The new and effective "intraintestinal thermal method" of treatment, which consists of the injection of a hot salt solution into the colon for the purpose of killing the amœbæ *in situ*, is not mentioned.

D. R.

CRAWFORD W. LONG AND THE DISCOVERY OF ETHER ANESTHESIA.—By FRANCES LONG TAYLOR. Pp. 237; 8 illustrations. New York: Paul B. Hoeber, Inc., 1928. Price, $4.00.

CRAWFORD LONG was unquestionably the first man to use ether for the purpose of producing surgical anesthesia, as Dr. Packard says in the Foreword of this booklet, and Morton the first to demonstrate its use before a professional gathering. It is generally admitted that there is glory enough for both. The ether controversy is a controversy no longer and the present book by Long's devoted daughter, who probably knew him better than any other, does not aim in any way to prolong it. Noncontroversial in tone, it succeeds in its aim to present "an absolutely truthful account of the life and work" of Dr. Long, and incidentally gives a delightful picture of a man who accomplished an incalculably valuable act, modestly and nobly, lived creditably through trying periods (both private and public) and died beloved of all who knew him.

E. K.

NEOPLASTIC DISEASES. A TREATISE ON TUMORS. By JAMES EWING, A.M., M.D., Sc.D., Professor of Pathology at Cornell University Medical College, New York City; Pathologist to the Memorial Hospital. Third edition revised and enlarged. Pp. 1127; 546 illustrations. Philadelphia: W. B. Saunders Company, 1928. Price, $14.00.

THE steadily expanding knowledge of neoplastic diseases has required rather extensive changes in the third edition of this trea-

tise. The chapter, Tumors of Bones, has been entirely rewritten on the basis of information obtained largely from the Codman *Registry of Bone Sarcoma*, and several new subvarieties of these tumors have been formally recognized. The classification of mammary cancer has been simplified, and brought more in accord with clinical varieties. The subject of brain tumors has been recast, brought in line with recent contributions in this field, and the newer nomenclature has been partly adopted. The most substantial feature of the revision has been the interweaving of a great number of phrases, sentences and paragraphs relating to matters of importance, both practical and theoretical. To make room for them, many minor references have been omitted. The insistent need of more illustrations—gross, microscopic and roentgenographic—has been critically considered, and about sixty new ones have been accepted. The value of this book remains undiminished. (See previous reviews in this *Journal*, 1922, **164**, 284, and 1919, **157**, 563.)

E. K.

THE EXAMINATION OF THE CENTRAL NERVOUS SYSTEM. By DONALD CORE, M.D. (MANC.), F.R.C.P. (LOND.), Honorary Assistant Physician, The Manchester Royal Infirmary. Pp. 248; 14 illustrations. New York: William Wood & Co., 1928.

AN outline of the technique of examination of the central nervous system, including motor and sensory phenomena, the cranial nerves, speech and the mental state. Elementary in scope and intended primarily for medical students, the book should nevertheless prove value to practitioners in offering them a facile means to refresh their knowledge of the subject.

K. K.

THE HARVEY LECTURES. Delivered under the auspices of the HARVEY SOCIETY OF NEW YORK, 1926–1927. By FRED NEUFELD, M.D., ROBERT CHAMBERS, M.D., LEONORE MICHAELIS, M.D., MERKEL H. JACOBS, M.D., JOSEPH ERLANGER, M.D., EDGAR L. COLLIS, M.D., and RICHARD WILLSTÄTTER, M.D. Series XXII. Pp. 176; 37 illustrations. Baltimore: The Williams & Wilkins Company, 1928. Price, $4.00.

THIS volume, the twenty-second in the series of Harvey Lectures, presents seven discussions representing advances in the medical arts and presenting the views of a group of distinguished experimenters.

CARDIAC ARRHYTHMIAS. By IRVING R. ROTH, M.D., Assistant in Medicine; Chief, Children's Cardiac Clinic, Mt. Sinai Hospital. Pp. 210; 80 illustrations. New York: Paul B. Hoeber, Inc., 1928. Price, $7.50.

ANOTHER good exposition of the cardiac arrhythmias with polygraphic and electrocardiographic records, yet with emphasis on the clinical characteristics of the various disorders considered. Discussions and authorities are almost entirely left to the larger books. It is questionable whether this book is worth the increase in price over the smaller books on the subject.

E. K.

THE SURGICAL TREATMENT OF MALIGNANT DISEASE. By SIR HOLBURT J. WARING, M.S., M.B., B.Sc. (LOND.), F.R.C.S. Pp. 667; 19 color plates; 277 illustrations. New York: Oxford University Press, American Branch, 1928.

THIS work is the outgrowth of the Bradshaw Lecture delivered before the Royal College of Surgeons, greatly elaborated, of course. The subject in the main has been treated from a clinical and surgical point of view and to the less extent from the pathologic standpoint insofar as it has a bearing on diagnosis or treatment.

The statistical features of this work are very valuable and, although not as full as could be desired, due to the youth of "follow-up," nevertheless are a great help to the reader. In addition to this one hospital's figures for twenty years the reports of many, many surgeons throughout the world are given in more or less detail. From this "results" standpoint alone the book holds a somewhat unique place and the reviewer at least welcomes it because it fills a want long experienced, namely, handy definite statistical data on what, how, when and how long. All teachers of medicine or surgery should own the volume.

E. E.

THE ABDOMINAL SURGERY OF CHILDREN. By L. E. BARRINGTON-WARD, CH.M., F.R.C.S. (EDIN.), F.R.C.S. (ENG.). Pp. 283; 82 illustrations. New York: Oxford University Press, American Branch, 1928.

THE author very correctly states that an adult may be safely treated as a child, but the converse can lead to disaster. This has long been recognized in medicine and it now has obtained in surgical matters also. Hence a work of this sort. It has often been stated also that surgical conditions are atypical in children. This is not true and the writer tries to show in this little book just why this is

untrue and further attempts to demonstrate how not to make the mistakes that are thereby incurred. The diagnostic features of the book are very good, the subject matter well presented and many of the illustrations are good, although some might preferably be used in a work on gross morbid anatomy rather than here.

E. E.

MONGOLISM: A STUDY OF THE PHYSICAL AND MENTAL CHARACTERISTICS OF MONGOLIAN IMBECILES. By KATE BROUSSEAU, Professor of Psychology, Mills College, Calif. Revised by H. G. BRAINERD, M.D., Member, Los Angeles Lunacy Commission. Pp. 203; 47 illustrations. Baltimore: The Williams & Wilkins Company, 1928. Price, $4.50.

IN this monograph is discussed an interesting scientific entity whose etiology is shrouded in mystery. Alcoholism, thyroid disturbance and syphilis have each had their advocates. Van der Scheer believes mongolism to be "a specific pathologic product," resulting from injury to the fetus at the sixth or seventh week of pregnancy and caused by amniotic compression, with a subsequent inadequate development of the centers at the base of the brain controlling the vegetative autonomic system. Crookshank's theory is that of atavism—reversion to an earlier type. The present writer offers no new theory, but speaks seriously of that time-honored belief—extreme age of one or both parents.

A most comprehensive diagnostic table differentiating mongolism, cretinism, achondroplasia and rachitis is given. The work includes numerous case reports and an extensive bibliography. While no new matter of consequence is offered, nevertheless, this is a painstaking study of an interesting though intricate subject. N. Y.

BOOKS RECEIVED.

New Editions.

Recent Advances in Medicine. By G. E. BEAUMONT, M.A., D.M. (OXON.), and E. C. DODDS, M.D., PH.D. Fourth edition. Pp. 426; 48 illustrations. Philadelphia: P. Blakiston's Son & Co., 1928. Price, $3.50. Four editions in five years testify to the value of this member of the Recent Advances Series.

Modern Methods of Treatment. By LOGAN GLENDENING, M.D. Second edition. Pp. 815; 95 illustrations. St. Louis: C. V. Mosby Company, 1928. Price, $10.00. "The purpose of this book is to present a comprehensive statement of the best modern thought and practice upon the treatment of diseases included in the general specialty of internal medi-

cine." The author substantiates this statement by including in this edition the liver treatment of pernicious anemia, the use of scarlet-fever antitoxin, parathyroid and ovarian hormones, ephedrin, novasurol, lipiodol, phenylhydrazin in polycythemia, the malarial treatment of paresis, etc. The changes of the sixteenth Pharmacopœia have been incorporated, and various new features added. This may be recommended as a sound, readable textbook, well revised.

Diathermy: Its Production and Uses in Medicine and Surgery. By ELKIN P. CUMBERBATCH, M.A., B.M. (OXON.). Second edition. Pp. 332; 87 illustrations. St. Louis: C. V. Mosby Company, 1928. Price, $7.00. "A complete revision and a considerable addition to its size." Doubtless specialists in this lucrative field can well afford a big price for a small book.

Operative Surgery. By J. SHELTON HORSLEY, M.D., F.A.C.S. Third edition. Pp. 893; 756 illustrations. St. Louis: C. V. Mosby Company, 1928. Price, $15.00. Much new material has been added.

Recent Advances in Hematology. By A. PINEY, M.D., CH.B. (BIRM.), M.R.C.P. (LOND.). Pp. 318; 22 illustrations, 4 in color. Second edition. Philadelphia: P. Blakiston's Son & Co., 1928. Price, $3.50. With a new section on the spleen in various infections. A useful and authoritative contribution.

New Books.

Technique of Contraception: The Principles and Practice of Anticonceptional Methods. Pp. 271; 25 illustrations. New York: Day-Nichols, 1928. Price, $7.50.*

Nutrition. By WALTER H. EDDY, PH.D. Pp. 237. Baltimore: Williams & Wilkins Company, 1928. Price, $2.50. Another manual by a competent authority on how to buy food, what to buy and what to eat.

The Mind of the Growing Child. Edited by VISCOUNTESS ERLEIGH. Pp. 229. New York: Oxford University Press, American Branch, 1928. Good lectures by child welfare experts to the intelligent mother.

Guy's Hospital Reports. April, 1928, Vol. 78, No. 2. Edited by ARTHUR F. HURST, M.D. Pp. 125. London: The Lancet, Ltd., 1928.

A Handbook of Clinical Gynecology and Obstetrics. By RAE THORNTON LA VAKE, A.B., M.D., F.A.C.S. Pp. 281; 35 illustrations. St. Louis: C. V. Mosby Company, 1928. Price, $4.00. Evolved from the teaching demands of the University of Minnesota and destined for undergraduate and graduate students.

Eat, Drink and Be Healthy. By CLARENCE W. LIEB, M.A., M.D. Pp. 180. The John Day Company, 1928. Price, $1.50. Containing a deal of common sense and sound advice together with some doubtful views, three virulent pages on the folly of spinach and pushing no particular fad.

The Collected Papers of the Mayo Clinic and the Mayo Foundation for 1927. Pp. 1330; 412 illustrations. Philadelphia: W. B. Saunders Company, 1928. Price, $13.00. Of 398 papers by over 150 contributors in 1927 (Faculty and Fellows of the Mayo Foundation); "100 are reproduced in full, 34 are abridged, 44 are abstracted briefly and 220 are referred to by title."

Medical Clinics of North America. Mayo Clinic Number, May, 1928. Pp. 330; 89 illustrations. Philadelphia: W. B. Saunders Company, 1928.

Progressive Medicine, June, 1928, vol. 2. Edited by HOBART AMORY HARE, M.D., LL.D. Pp. 408. Philadelphia: Lea & Febiger, 1928.

* Review of title followed by an asterisk will appear in a later number.

PROGRESS

OF

MEDICAL SCIENCE

MEDICINE

UNDER THE CHARGE OF

W. S. THAYER, M.D.,

PROFESSOR OF MEDICINE, JOHNS HOPKINS UNIVERSITY, BALTIMORE, MARYLAND,

AND

JOHN H. MUSSER, M.D.,

PROFESSOR OF MEDICINE, TULANE UNIVERSITY OF LOUISIANA, NEW ORLEANS.

Mechanically Stimulated Ventricular Extrasystoles in Man.—Fossier (*J. Am. Med. Assn.*, 1928, **90**, 1103) presents some very interesting data, which were collected by him from studies of an individual with congenital malformation of the sternum in whom the frontal portion of the heart was bare except for a thin layer of skin and subcutaneous tissue. He concluded from his studies that the premature contractions originate from the base of the heart when the main deflections of the electrocardiographic string are upright in Leads II and III; whereas, those in which the main deflections are inverted come from the apical region of the heart. He suggests that the present terms of right ventricular extrasystole and left ventricular extrasystole be abandoned and in their place should be used the terms, apical extrasystole, basal extra systole and intermediate extrasystole.

Synthalin.—Synthalin was introduced to the medical profession by Frank, working in Minkowski's Clinic in 1926. Since then there have been a goodly number of reports on the use of this synthetic compound, decamethyldiguanidine, in the treatment of diabetes. The early reports emanated from European clinics. In the last few months reports from English literature have begun to come out in the current medical literature. An account of the use of the drug by Ringer, Biloon, Harris and Landy (*Arch. Int. Med.*, 1928, **41**, 453) deserves to be commented upon because of the 4 cases that were studied with infinite detail and great care. Reports such as this are probably of greater value than those of a large series of poorly worked-up cases. These authors selected for study 1 case of severe diabetes, 1 case of moderate and 2 of comparatively mild diabetes. The patients were put on test periods and control periods of varying length of time, averaging approximately nine days each. Exact food intake, blood sugar, body weight, dextrose secreted and in some cases the nitrogen partition were followed. In brief, these workers find that there is a very definite physio-

logic result from the use of synthalin in reducing glycosuria and in causing a corresponding drop in blood sugar. In addition to this fact, synthalin definitely affects favorably the course of ketonuria. They conclude that the discovery of synthalin is a tremendous step in the right direction and that in certain types of cases, such as comparatively mild diabetics and those patients without ketonuria and in the case of individuals who are unable to suffer the discomforts of insulin injections, that the synthetic compound is of tremendous value.

Hemocidal Properties of the Blood Serum: With Special Reference to Pernicious Anemia.—HORRALL and BUCHMAN (*Arch. Int. Med.*, 1928, **41**, 482) first review the evidence that has been brought forth to show that pernicious anemia is a condition which is associated with increased hemolysis that is due to a hemolytic substance which resides somewhere within the human economy, possibly, but not certainly within the spleen. This increased tendency to hemolysis may reside in the cells themselves or in the serum, which acts on the red cells. They, therefore, tested out the fragility of the red cells in various blood dyscrasias, contrasting the effect of various dilutions of salt solution upon normal cells and normal serum, normal cells and abnormal serum, abnormal cells and salt solution, abnormal cells and normal serum and abnormal cells and abnormal serum. They find that in certain conditions hemolytic substances which may act *in vitro* as well as in the blood stream are present in the blood serum. A substance hemolytic to its own red cells is present in the relapses of pernicious anemia, in hemolytic jaundice, and in septic anemia. The red cells are abnormal in polycythemia, secondary anemia and aplastic anemia. Reticulated cells are more resistant than the nonreticulated. The authors point out that the test is of value in differentiating the several types of anemia.

SURGERY

UNDER THE CHARGE OF

T. TURNER THOMAS, M.D.,

ASSOCIATE PROFESSOR OF APPLIED ANATOMY, SCHOOL OF MEDICINE AND ASSOCIATE PROFESSOR OF SURGERY, GRADUATE SCHOOL OF MEDICINE IN THE UNIVERSITY OF PENNSYLVANIA; SURGEON TO THE PHILADELPHIA GENERAL AND NORTHEASTERN HOSPITALS.

Surgical Drainage of the Seminal Vesicles and Prostate.—MORRISSEY (*Surg., Gynec. and Obst.*, 1928, **46**, 341) says that acute suppuration in and about the seminal vesicles and prostate which does not quickly respond to palliative measures, should be given perineal drainage. Many cases of ischiorectal, perirectal and superior pelvorectal abscesses and urinary extravasation have their origin in a perivesical cellulitis and in the common treatment of the condition the original focus is usually entirely forgotten or disregarded. In this respect they are analogous to peripelvic infiltration, secondary to chronic tubal suppuration in the female and are equally a source of chronic infection.

Prostatotomy and vesiculotomy are most effective in the treatment of acute and chronic joint conditions and should be practised more freely. Operation usually gives immediate relief from pain, prevents gross joint changes and induces hastened resolution of the inflammatory areas. Drainage should be maintained for at least ten days and is of utmost importance in the after treatment.

Certain Difficulties in the Diagnosis of Exophthalmic Goiter.—HAINES (*J. Iowa State Med. Soc.*, 1928, **18**, 53) states that the exophthalmic goiter is a disease associated with an unknown stimulus on the thyroid gland, resulting, according to H. S. Plummer's hypothesis, in the production and delivery to the tissues of an abnormal thyroid secretion and almost invariably an excessive amount of normal thyroxin. The symptoms and signs of exophthalmic goiter are those which are dependent on an increase in the body metabolism, and also on certain characteristic phenomena, which may be assumed to be dependent on the presence in the tissues of an abnormal thyroid agent, the exact nature of which is not known. These phenomena are exophthalmos, stare which may be present with or without exophthalmos, tendency to diarrhea and vomiting, gastrointestinal crises and a peculiar psychic state characterized by irritability and frequent useless purposeful movements. Hyperfunctioning adenomatous goiter is characterized by those phenomena which are dependent on an increased basal metabolic rate and are identical with the phenomena produced by feeding an excessive quantity of desiccated thyroid. There are certain signs which are helpful in differentiation in any proved case of hyperthyroidism. Definite absence of adenomas in the gland is for practical purposes presumptive evidence of exophthalmic goiter. In from 20 to 30 per cent of the cases of exophthalmic goiter seen at the Mayo Clinic adenomas are present in the gland, so their presence does not make the diagnosis of hyperfunctioning adenomatous goiter. Bruits over the superior pole and the finger and toe nails frequently give diagnostic aid in exophthalmic goiter. Historic evidence may be of value in the differentiation of the two conditions; hyperfunctioning adenomatous goiter is usually gradually progressive and exophthalmic goiter usually progresses with remissions. Aside from the cases of hyperthyroidism those most frequently presenting difficulty in differential diagnosis are the states of fatigue, designated as neurosis, neurasthenia, chronic nervous exhaustion and so forth.

Certain Effects of Obstruction of the Bile Duct.—COUNSELLOR (*Ann. Surg.*, 1928, **87**, 210) reports that the biliary trees of 26 livers were examined by the colloidin injection and corrosion method. In 10 normal livers the internal diameter of the common hepatic (common bile) ducts did not exceed 5 mm. and the diameter of the succeeding branches diminished to 0.05 mm. in the fifth subdivision of biliary passages (terminal branches). There was general enlargement of the ducts in 7 of 8 livers in which the gall bladders contained unsuspected stones, 6 to 11 mm. in diameter. The dilatation was slightly greater when the injury to the gall bladder was more severe than in the cases of unsuspected stones. Moderate dilatation was found in 3 cases in which cholecystectomy had been performed several days prior to death. In 5 cases in which benign or malignant strictures of the common duct

existed the amount of dilatation was great and the diameter of the common hepatic duct varied from 10 to 30 mm. The process extended throughout the whole biliary tree, grossly as far as the fifth order of branches. Marked engorgement of portal vein radials occurred following marked dilatation of the bile ducts and was associated with atrophy of the hepatic parenchyma in the areas supplied by the obstructed portal branches. The parietal sacculi and vasa aberrantia were studied in this series of cases. In normal biliary trees the parietal sacculi were seen as small sacculations appearing in two rows on opposite sides of the ducts, decreasing in size as the ducts diminished in caliber. The vasa aberrantia were seen extending beyond the wall of the duct and anastomosing with each other frequently. These structures, like the parietal sacculi, were unchanged in size and numbers following extensive diseases of the gall bladder and cholecystectomy. In cases of choledocholithiasis and benign and malignant strictures the vasa aberrantia were tremendously enlarged and sacculated, corresponding in degree to the amount of dilatation of the duct. The parietal sacculi appeared to be absorbed by the wall of the dilating duct while the vasa aberrantia were enlarged as a result of the increase in the intraductal pressure, proportionate to the amount of dilatation of the ducts themselves.

Causes of Death in Acute Intestinal Obstruction.—GATCH, *et al.* (*Surg., Gynec. and Obst.*, 1928, **46**, 332) say that the toxemia of intestinal obstruction is closely allied to that of surgical shock if not identical with it. For this reason, these patients withstand general anesthesia, especially ether anesthesia badly, and should be subjected to the least possible amount of operative trauma. The operation should always be preceded by the intravenous administration of a considerable quantity of physiologic sodium chlorid solution. An intestinal anastomosis should never be undertaken in the presence of a great distention of the bowel. The seminecrotic tissues cannot be sutured safely. Furthermore, there are fresh surfaces opened for rapid absorption of toxic material and the paralytic ileus which remains prevents adequate evacuation. An additional factor contributing to the disaster is the initial shock of a difficult operation which may be fatal in a very few hours. The gangrenous loop should be excised and a "gun-barrel" enterostomy performed. When the patient has completely recovered from this operation an intestinal anastomosis can be safely established.

A Discussion on Ultraviolet Therapy.—AITKEN (*Edinburgh Med. J.*, 1928, **35**, 49) believes that the carbon-arc lamps are superior to the mercury-vapor lamps. This view is held by Ganvains, who some months ago stated that the mercury-vapor lamp was a long way behind the carbon lamp. It has been stated at the Finsen Institute that the heat and light rays enhance the effect of the ultraviolet and the author has had experience confirming this, at all events with regard to the heat rays. The author is convinced that in ultraviolet radiations we have the finest possible tonic. In general, one might say that any debilitated condition responds readily to radiations. Debility following operation will vanish in almost a remarkable way and the return to full health and strength will be greatly accelerated. Weight and appetite increase in a way which sometimes makes the patient ashamed.

THERAPEUTICS

UNDER THE CHARGE OF

CARY EGGLESTON, M.D.,

ASSISTANT PROFESSOR OF CLINICAL MEDICINE, CORNELL UNIVERSITY MEDICAL COLLEGE, NEW YORK CITY.

Treatment of Malignant Diphtheria with Combined Diphtheria and Streptococcus Antitoxin.—Bacteriologic studies by special technique on a series of cases of malignant diphtheria showed, in MEYER'S hands (*Deutsch. med. Wchnschr.*, 1928, **54**, 215) that a rich growth of a hemolytic streptococcus was present along with the diphtheria bacillus. This streptococcus produced a toxin similar to that of diphtheria in that it caused necrosis and severe exudative inflammation in the heart muscle and the liver, and also produced a marked hemolytic anemia. The author was able to produce a potent antitoxin against this organism, and he believes that the use of this antitoxin is necessary in the treatment of the malignant cases of diphtheria. FINKELSTEIN and KÖNIGSBERGER (*Ibid.*, p. 218) report on the combined treatment of these malignant cases with the simultaneous administration of both diphtheria and the streptococcus antitoxins. In a series of 49 toxic cases treated by diphtheria antitoxin alone the mortality was 87 per cent, while in the next group of 47 cases, in which both antitoxins were employed, the mortality was only 44 per cent. The two series were sequential and not parallel, hence, as the authors say these figures can, at most, be regarded as suggestive of the value of the new antitoxin. They observed no advantage in the combined treatment over diphtheria antitoxin alone in those exceedingly unfavorable cases which begin with evidences of hemorrhagic diathesis. Further, the late, postdiphtheritic paralyses which appear from seven to eleven weeks after the acute stage were uninfluenced by the use of the combined treatment. The dose of the streptococcus antitoxin employed by the authors ranged between 25 and 75 cc., and did not of itself produce untoward reactions. In the opinion of the authors this combined form of treatment deserves further investigation as it seems to offer considerable promise in an otherwise very fatal type of diphtheria.

Endotracheal Application of Adrenalin in the Treatment of Pulmonary Hemorrhage.—GIUFFRIDA (*München. med. Wchnschr.*, 1928, **75**, 302) has employed adrenalin solution by direct instillation into the trachea, after preliminary anesthetization of the pharynx, for the control of hemoptysis in 50 patients suffering from pulmonary tuberculosis. In 2 patients it was not possible, successfully, to introduce the adrenalin into the trachea. In 3 others, although the introduction was successful, the bleeding was not controlled. In the remaining 45 hemorrhage was checked more or less promptly. All these 12 were completely controlled by a single injection and 33 required repeated applications over a period of several days, in order to effect complete stoppage of the hemoptysis. The hemorrhage was checked immediately in 15

cases, while in the remainder it ceased within a short time after the application of the adrenalin. The control of bleeding lasted for twelve hours in the majority of patients and it was found necessary to repeat the administration of adrenalin, in most cases, at intervals of about twelve hours for two or three days, in order to make sure of permanent control. The dose employed was 1 cc. of the 1 to 1000 solution, diluted with twice as much water, in order to provide a volume sufficient to spread over a considerable area in the bronchial tree. The author points out that it is necessary always to employ a potent preparation of adrenalin since this drug frequently deteriorates and weak specimens fail to produce the desired effects. Along with his use of adrenalin in this manner, he made observations on the patients' blood pressures at varying intervals of time, following its intratracheal injection. In no instance was he able to observe any elevation of the patients' systemic blood pressures.

Barium Chlorid in Ventricular Standstill.—The administration of barium chlorid for the control of syncopal attacks in complete heart block is a procedure of established, though somewhat limited, therapeutic value. STRAUSS and MEYER (*Am. Heart J.*, 1928, **3**, 328) review the literature of its use in this condition and add a detailed report of their successful employment of this drug for the control of transitory attacks of complete ventricular standstill occurring in a patient subject to partial block. Daily doses as small as 120 mg. effectively prevented the recurrence of the attacks of ventricular standstill, and the continued administration of the drug restored the normal sinus rhythm for a period of ten months. The administration of 40 mg. three times a day caused no harmful effect. Experimentation on this patient established the fact that the drug should be administered continuously rather than intermittently. In the course of the observations on this patient the authors found that adrenalin gave no permanent relief, and that atropin was almost always useless. Potassium iodid, on the other hand, increased the frequency of the patient's attacks, even when administered in small doses, indicating a depression of ventricular irritability, probably due to the action of the potassium ion. Although the patient ultimately died, the treatment seemed effective in preventing the development of a complete block.

The Successful Administration of Insulin in the Presence of Addison's Disease.—The possibility of carrying out satisfactory insulin treatment for diabetes in patients who are also suffering with Addison's disease is well illustrated by the detailed reports of two cases presented by UMBER (*Med. Klin.*, 1928, **24**, 8). He briefly reviews the literature of similar cases, and points out the theoretical danger of the induction of insulin shock in the presence of the very low blood pressure characteristic of Addison's disease. In these cases he was able, by beginning with very small doses of insulin along with the administration of adequate quantities of carbohydrates, completely to control both the glycosuria and the hyperglycemia. In one of the cases slight hypoglycemia appeared, but this was not associated with symptoms of shock. On the contrary, during its presence the blood pressure rose slightly, a fact which seems to confirm the view that insulin is capable of stimulating the suprarenal glands under certain circumstances.

PEDIATRICS

UNDER THE CHARGE OF

THOMPSON S. WESTCOTT, M.D., AND ALVIN E. SIEGEL, M.D.,

OF PHILADELPHIA.

Scarlet Fever.—The Development of Toxin Sensitivity of the Skin in Infants and its Relation to the Presence of Antitoxin in the Blood.—COOKE (*Am. J. Dis. Child.*, 1928, **35**, 762, 772, 781, 784) states that the skin sensitivity to scarlatinal streptococcus filtrate toxin, which was present in only a small number of infants at birth, increased slowly during the first six months and more rapidly during the last half of the first year. It remained high from the second to the sixth year and fell during the school age period. Skin tests made with varying amounts of toxin showed similar variation according to the age of the subject. In the first half year the skin of a majority of infants was not sensitive to large amounts of toxin, and that of many others which were insensitive to small doses, was positive only to large amounts. In many other infants tested demonstrable antitoxin was not present in the blood. Such infants with little if any skin sensitivity and without antitoxin could be found at the second year. Antitoxin was always demonstrable in children more than two years of age and in adults not sensitive to small amounts of antitoxin.

Modification of Skin Sensitivity to Toxin as a Result of Nonscarlatinal Infection.—In a study of more than 100 apparently well, healthy children not isolated from one another, in a foundling home, COOKE (p. 772) observed that the skin sensitivity to scarlatinal streptococcus filtrate toxin was greatly decreased in this group of children when compared with healthy children of the same ages from isolated homes. In a few of the children so tested the decreased skin sensitivity was apparently due to the immunity accompanying circulating antitoxin. It was also found that the incidence of hemolytic streptococci in cultures from the pharynx of children in the institutional group was much greater than from a control group from isolated homes. In the study of filtrates from the strains of hemolytic streptococci isolated from the pharynx, the skin reactive substance, apparently identical with scarlatinal toxin was demonstrated in some of the strains but not in all. This was neutralized by convalescent scarlet-fever serum containing antitoxin.

Toxin Production by Hemolytic Streptococci from Nonscarlatinal Infections in Infants.—COOKE (p. 781) found that hemolytic streptococci were relatively frequent as a cause of infections of the upper respiratory tracts in infants, especially of those which involved the ear and the mastoid. Culture filtrates from many of these strains gave skin reactions which were apparently identical with those of filtrates from strains of hemolytic streptococci of scarlatinal origin and which were only neutralized by serums capable of neutralizing scarlatinal toxin. In filtrates from other strains the skin reactive substance was not similarly specific and neutralized.

The Changes in Skin Sensitivity to Scarlatinal Streptococcus Filtrate.—In children following the introduction of homologous serums COOKE (p. 784) found that the skin of certain infants in the latter half of the first year was not sensitive to considerable amounts of scarlatinal streptococcus filtrate toxin, and that it had little, if any, neutralizing antibody in the blood. The introduction into these infants from a person whose skin was sensitive to a small quantity of filtrate toxin was followed in several cases by a gradual increase in the skin sensitivity of the recipient. In older children in whom lack of skin sensitivity was accompanied by the presence of antitoxin in the blood, an alteration in the sensitivity was not noted after the introduction of such homologous serums. The administration of normal serum which contains neutralizing antibody was followed by marked decrease in the sensitivity in the skin of the recipient and Cooke suggests an apparent analogy between this induced sensitivity in infants and a passive anaphylactic hypersensitivity.

A Case of Congenital Sarcoma.—HECKER (*Zentralbl. f. Chir.*, 1928, **55**, 842) reports a case of congenital tumor in a child, aged three months. It was located in the left gluteal region. The tumor was removed and microscopic study revealed a spindle-cell sarcoma. Three weeks after the operation a new growth was noted in the region of the scar, but there was no metastasis. A wide excision into healty tissue was made. Four months later on examination there was no evidence of recurrence, and the child was developing normally. From the evidence in this case, it would seem that this rare type of congenital sarcoma had been removed before metastasis had occurred.

Cerebellar Tumors Occur in Identical Twins.—LEAVITT (*Arch. Neurol. and Psych.*, 1928, **19**, 617) holds that the identical occurrence of cerebellar tumors in monozygotic twins may be construed as strong evidence in support of the "fetal rest" of neoplastic tissue. The first twin died at the age of six and a half years and the second twin at the age of eight and a half years. The latter had manifested no evidence of the illness at the time of the death of the first twin. Both twins had cerebellar neoplasms in the same locations, and the structure of the tumors examined were composed of embryonic cells. As it is believed that monozygotic twins developed as the result of a single fertilized ovum, it would seem probable that both of these tumors were due to a fetal rest of embryonic tissue remaining as a pathologic nidus in the roof of the fourth ventricle of each twin, where it remained in a quiescent state for a number of years until some factor stimulated the pathologic growth of this group of embryonic cells, first in the one twin and then in the second.

Cerebrospinal Fluid Pressure in the Newborn.—MUNRO (*J. Am. Med. Assn.*, 1928, **90**, 1688) measured the cerebrospinal fluid pressure 142 times in 95 newborn babies. Of these measurements, 139 were made on lumbar puncture and the remaining 3 on ventricular puncture. The normal cerebrospinal fluid pressure in the newborn as determined from figures obtained from patients treated for cranial and intracranial injury and discharged, lies between 6 and 2 mm. of mercury. A

reading below 2 mm. of mercury was found in this series only in the presence of surgical shock or of dehydration. Increased cerebrospinal fluid pressure was present in every case of depressed fracture, intracranial hemorrhage, cerebral edema or cerebral congestion. Intracranial trauma in the newborn may be safely reduced to normal by lumbar puncture regardless of the degree of hypertension. Patients discharged as relieved and symptom free with a known cerebrospinal fluid pressure between 6 and 2 mm. of mercury showed a late death and disease percentage of 11.4 from all causes and of 5.8 from known cerebral causes alone. Patients discharged as relieved and symptom free, with a known cerebrospinal fluid pressure of more than 6 mm. of mercury, showed a late death in disease percentage of 37.5 from all causes and of 25 from known cerebral causes alone.

The Association of Pylorospasm and Thymic Enlargement in Children.—RUBIN (*J. Am. Med. Assn.*, 1928, **90**, 1694) was much impressed by the roentgenograms of cases of vomiting with suspected pyloric stenosis in which enlargement of the thymus was discovered. In addition to this, there is frequently found in these cases of vomiting a history of disturbances of respiration. He studied 13 nonselected consecutive cases of pylorospasm, and in all of these an enlarged thymus was shown by the roentgenogram. More than one-half of these patients had symptoms suggestive of thymus enlargement, such as breath holding and cyanosis. As result of Roentgen ray treatment alone 5 of these cases, which were the only ones treated in this manner, showed improvement. This frequency of association is very interesting, but the series is not of sufficient size to justify positive conclusion of relationship, especially as other authors have reported as much as 50 per cent incidence of enlarged thymus in sundry conditions.

OBSTETRICS

UNDER THE CHARGE OF

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The Influence of Supplementary Feeding of Carbohydrate Upon Lactation.—The investigation of carbohydrate foodstuffs as a possible galactogogue when administered in addition to an adequate diet is reported by KLEINER, TRITSCH and GRAVES (*Am. J. Obst. and Gynec.*, 1928, **15**, 172). The starchy foods selected for this study were rice and tapioca for the reason that tapioca has been claimed as a galacta-

gogue and rice could be used as a control; both are relatively inexpensive, can be prepared in a variety of ways and can be made into similar dishes. Rice, however, is a cereal, while tapioca is derived from a tuber; the starch of both is completely digestible. Three groups were studied. Group 1 were given regular hospital ward diet; Group 2 the hospital diet plus rice; Group 3 the hospital ward diet plus tapioca. The experiments were conducted simultaneously on normal cases. On Group 4, controls, the tapioca or rice was replaced by an amount of cream equivalent in calories. The hospital diet had a caloric value of about 2600 while the other diets were increased to a total of about 3000 calories. The effect of increasing the proportion of carbohydrate or fat in the diet has been the following during the early days of lactation as found in a study of 130 cases: (1) The time of appearance of milk in the mother's breast is uniform in all groups. (2) The greatest volumes of milk were ingested by the infants in the tapioca and rice groups. (3) The greatest volume of milk obtained by the breast pump were likewise from the tapioca and rice-fed mothers. (4) The protein content of the milk was about the same in all four groups. (5) The cream diet was the only one to increase the fat content of the milk on the fifth day; by the ninth day all groups had about the same percentage of fat. (6) The cream diet and the tapioca diet both increased the lactose content of milk on the fifth day; on the ninth day the rice group also had milk which contained a high percentage of sugar. (7) These changes in the milk in the early days of lactation, when expressed in calories per specimen obtained indicate a greater fuel value available to the infant in those cases in which the mother received a high-carbohydrate diet.

The Prognosis in Acute and Chronic Nephritis of Pregnancy from the Standpoint of Classification.—The relationship of nephritis to pregnancy is studied by MUSSEY and KEITH (*Am. J. Obst. and Gynec.*, 1928, **15**, 366) in a series of 14 cases, with studies of the blood pressure and renal function. Patients with an acute nephritis rarely give a history of previous renal trouble. The presence of albuminuria, the rather sudden rise in the blood pressure and increased edema usually occur during the eighth or ninth month. Tests of renal function show adequate excretion aside from oliguria, the specific gravity of the urine is high and the ocular fundi may reveal evidence of acute changes in the vessels and retina. Patients with chronic nephritis often give a history of previous nephritis, albuminuria, hypertension and edema are apparent earlier in pregnancy, usually before the seventh month. Tests of renal function often disclose retention of nitrogen and phenolsulphonephthalein. The specific gravity of the urine is fixed or low and there is definite secondary anemia. Examination of the ocular fundi often reveals changes resulting from previous nephritis. Most pregnant women with acute nephritis recover with little or no demonstrable impairment of renal function. In some cases the disease will progress to a chronic stage. Most women with a history of nephritis but no gross impairment of renal function can be carried safely through pregnancy under careful supervision. Chronic nephritis with seriously lowered renal function distinctly increases the hazard to mother and child.

Porro Cesarean Sections under Local Infiltration Anesthesia.—The use of local (infiltration) anesthesia is coming into greater fields in obstetrics. GREENHILL (*J. Am. Med. Assn.*, 1928, **90**, 1023) reports the performance of supravaginal hysterectomy after Cesarean section in 4 cases without any difficulty, using local infiltration. For the local anesthetic 0.5 per cent procain hydrochlorid is used, to which, after sterilization, 2 drops of 1 to 1000 epinephrin are added for each ounce. The average amount of anesthetic used for this operation was approximately 8 ounces. Patients are given $\frac{1}{4}$ gr. of morphin and $\frac{1}{200}$ gr. of scopolamin just as the injection of the skin is begun and after infiltration, and the abdominal wall is opened in the usual manner. A point of particular interest is the injection at one spot of $1\frac{1}{2}$ to 2 ounces of the anesthetic solution under the loose peritoneum between the bladder and the lower uterine segment and by means of a finger the solution is spread beneath the bladder and out into the broad ligaments. No further anesthetization is required until after the child is delivered. The uterus is then very gently lifted out of the abdominal cavity and a small amount of the solution injected subperitoneally on the posterior wall of the uterus along the line of amputation from one broad ligament to the other. The operation is then completed by the usual technique with no further anesthesia. In doing this operation under infiltration anesthesia it is essential that all pulling and tugging be avoided.

GYNECOLOGY

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Total Versus Subtotal Operation for Uterine Fibroids.—Although much has been written on the subject of the proper type of operation in the removal of uterine fibroids, there still remain two diverse opinions, one school advising the total removal of the uterus while the other school champion supravaginal hysterectomy. An interesting analysis of this subject has been presented by KRIWSKY (*Zentralbl. f. Gynäk.*, 1927, **51**, 2190), based on the work in his clinic in Leningrad. He reminds us that the chief objection to the supravaginal operation to the possibility of malignant change in the retained stump. The combination of carcinoma of the fundus and myoma is frequent enough that every uterus removed for myoma should be opened and inspected as soon as removed and before the completion of the operation so as not to overlook any complicating carcinoma, since the presence of any car-

cinoma always calls for total extirpation of the uterus with the adnexa. The statistics which he presents from his clinic during the years 1910 to 1926 show that there were 643 cases of myoma operated upon with a total mortality of 3.7 per cent. Of these cases 162 were operated upon by vaginal hysterectomy with 2.5 per cent mortality, 160 had a supravaginal hysterectomy with 1.9 per cent mortality and 175 had total hysterectomy with 7.4 per cent mortality. In regard to the type of case submitted to each operation, an analysis shows that 67.5 per cent of the cases which had a supravaginal operation were simple uncomplicated cases while 66.2 per cent of those that had a complete extirpation were not complicated by any other pelvic disease so that the argument so often advanced, that complete hysterectomy is used more frequently in complicated cases, is not borne out in this series. The duration of the patient's stay in the hospital after operation was found to be shorter after the subtotal operation. The convalescence was febrile in 36.5 per cent of the patients on whom the total operation was performed in contrast to 23.1 per cent after the subtotal operation. Similarly the postoperative complications occurred in only 24.4 per cent of the subtotal cases as opposed to an incidence of 32.5 per cent after the total operation. It is interesting to note, however, that pneumonia was more frequent after the subtotal operation (5.6 per cent) than after complete removal (3.4 per cent). He concludes that these statistics do not indicate that one operation is always the correct one, but that the operation to be used depends upon the type of case under consideration and in certain cases the complete operation is preferable, even though it has a higher morbidity and mortality.

Contraindications to Radium.—It is perhaps just as important, if not more so, to know when not to use radium as it is to know when radium is indicated in the treatment of uterine cancer. According to STRACHAN (*J. Obst. and Gynec. Brit. Emp.*, 1927, **34**, 291), in cases blanched from excessive blood loss radium treatment is often followed by severe systemic disturbance, shown by pelvic pain, nausea and irregular pyrexia with an occasional rigor. Generally speaking, the local result of treatment is not good in such cases, the symptoms are not influenced and early death ensues. In such cases the anemia should first be treated by rest and the administration of iron or blood transfusion before radium is applied. He believes that with a red cell count of less than 3,500,000 radiation is undesirable and that with a count below 3,000,000 it is contraindicated. A foul sloughing surface to the carcinoma is a second contraindication. In such cases immediate radium treatment is apt to be followed by massive necrosis and considerable toxemia. Such cases should be treated by douching and by swabbing the foul surface from time to time with iodized phenol until the surface is clean. If a pyometra is found radiation should be delayed until the uterine cavity has been thoroughly drained. He makes it a routine practise to explore the cervical canal in all cases in order to detect this complication, and it is worthy of note that in every case in which pyometra has been found it was unexpected, there being no pyrexia or abnormal uterine enlargement. The presence of inflamed appendages would also cause one to postpone radium treatment. This complication may be very difficult to elicit even under anesthesia, but if it is suspected radiation should

be postponed until the condition has subsided under rest and palliative douching. Fistula formation is an absolute contraindication for radium, and if such a complication develops during treatment radium should not again be applied. Undoubtedly most of those who work with radium are well acquainted with most of these contraindications, but the referring physicians should be better acquainted with them so that they will not insist on the application of radium to patients whose condition will only be made worse by such treatment.

OPHTHALMOLOGY

UNDER THE CHARGE OF

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A Case of Severe Chronic Nephritis Showing Remission of Albuminuric Retinitis.—SCRIVER (*Canadian Med. Assn. J.*, 1928, **18**, 418) reports a case, a French Canadian housewife, aged forty-two years, who was seen in the eighth month of pregnancy, complaining of headache, dizziness and blood in the urine. The mother of fifteen full-term live children, she had lost four at intervals between the successful pregnancies; the last child, the twenty-first pregnancy, was born dead at the eighth month. Upon admission, her blood pressure was 258 systolic and 108 diastolic; there was moderate edema of the feet; the urine was grossly bloody with specific gravity 1012 and a large amount of albumin was present but no casts. Following delivery the blood pressure was reduced to 165 systolic and 70 diastolic. The fundi showed severe albuminuric retinitis. Her progress was satisfactory for three months, when she developed serpiginous ulcers of both eyes. There was no indication of albuminuric retinitis. The history and physical findings, together with the various tests of renal function, show that this is a case of moderately severe chronic nephritis. While the total disappearance of albuminuric retinitis has been observed in acute nephritis, yet we usually think of such a condition of the fundus in chronic nephritis as permanent and of very grave prognostic importance.

The Location of the Focus in Optic Nerve Disturbances from Infection.—WHITE (*Ann. Otol., Rhinol. and Laryngol.*, 1928, **37**, 128) states that some focus in the body is responsible for the optic nerve lesion arising from infection. Invasion is through the blood stream. The accessory sinuses supply but an insignificant number of the foci. Most of the foci are in teeth and tonsils. The focus may be found in the appendix, gall bladder, prostate, Fallopian tubes, genitourinary or intestinal tracts. Thirty cases reported—various operations were performed upon 27 (teeth, tonsils and so forth). Normal vision was obtained in 63 per cent of the cases undergoing operations, while 20 per cent improved. In the remaining 17 per cent which were chronic, further loss of vision was prevented. The ethmoids were opened but once, the sphenoid twice and the antrum four times. Over 80 per cent of the cases had infected teeth or tonsils or both.

OTO-RHINO-LARYNGOLOGY

UNDER THE CHARGE OF
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Differentiation Between Ophthalmic and Sinus Headaches.—In discussing the subject of headache FENTON (*Ann. Otol., Rhinol. and Laryngol.*, 1927, **36**, 1000) considers the mechanism whereby this symptom becomes manifest and summarizes the evidence presented by saying that, in general, headache from the eyes and paranasal sinuses is representative of local pathology, which is often actuated through the sympathetic system, while it is reported to the site of the headache through the fifth cranial nerve and its connections. Perceived within or about the cranium, it may, by reflex stimulation of the sympathetic at the perceiving area, set up local vasomotor disturbances within the dural envelope which may greatly aggravate the intensity of the original headache. Conversely, conditions within the brain or along the sympathetic or sensory nerves may actuate perceptory mechanisms within or about the eye or the sinuses, thus producing irritations or congestions which appear to be local. The mechanism, distribution and time of occurrence of sinus headaches, according to Skillern, is given. Local factors of ophthalmic headaches are divided into three main groups—disturbances of motility, disturbances of refraction and accommodation and disturbances of retinal function—which are discussed. The author summarizes his observations relative to the differential diagnosis between headaches of ocular and sinus origin by emphasizing the importance of the history of the case, not forgetting familial tendency, recurrence, exposure and amount and nature of use of the eyes; by admonishing search for nasal deformities, obstructions, inflammatory processes and neoplasms, as well as for circulatory and inflammatory disturbances in the eyes, and changes in tension and in appearance of media, retina and optic nerve, muscular insufficiencies, and refractive and accommodative errors; by describing how to set at rest the various nerves or groups of nerves involved in the particular case; by indicating that headache may be psychic and that ocular and sinus headaches may be coexistent. He concludes by saying that "No task in diagnosis is more difficult than the evaluation of all factors in these complex cases. Nowhere in medicine is an accurate history more valuable. . . . Differential diagnosis can never rest upon headache alone."

Incidence of Rheumatism, Chorea and Heart Disease in Tonsillectomized Children: A Control Study.—The great problems in the control of heart disease in children are the determination of the unknown factors in the etiology and the methods of prevention of chorea, rheumatic fever and other infections which are generally assumed to be present before the cardiac valves are involved. As frequent attacks of sore throat may precede these infections, the tonsils have been

regarded as a likely portal of entry and perhaps a factor in their occurrence. Inasmuch as there have been conflicting opinions relative to the influence of the tonsils on the various rheumatic symptoms, KAISER (*J. Am. Med. Assn.*, 1927, **89**, 2239) has attempted to clarify the situation by observing a large group of children in whom the tonsils had been removed before any rheumatic symptoms were manifest and in whom the tonsillectomy had been performed at least five years previously. Similar observations were made on a group of children, living in the same environment, who had not been tonsillectomized. Accordingly, the data on 20,000 school children with tonsillectomy and 28,000 without tonsillectomy are reported. Rheumatic fever, joint pains or growing pains occurred in 8 per cent of the tonsillectomized group and in 10 per cent of the nontonsillectomized group. Many of the former had had rheumatic manifestations before tonsillectomy. The tonsillectomized child not yet infected has a decidedly better chance to escape rheumatic infection over the same period of time than the child whose tonsils have not been removed. Recurrent attacks of rheumatic fever were less common in those upon whom the operation had been performed. Chorea occurred only slightly less often, 0.4 per cent as compared with 0.5 per cent in the tonsillectomized group. The incidence of carditis following chorea was decidedly less in the tonsillectomized children. Scarlet fever occurred in 7.6 per cent of those with their tonsils removed, and in 16 per cent of those who had not been tonsillectomized. Here, again, valvular heart disease occurred less frequently following scarlet fever in the tonsillectomized group. Rheumatic heart disease was found in 450 of the 20,000 tonsillectomized children and in 817 of the 28,000 who were not operated upon. A careful analysis of 478 cases of carditis showed that in 83 per cent the condition developed before tonsil removal, and in 17 per cent following tonsillectomy. The author concludes that "Based on a control study of 20,000 tonsillectomized children, it must be concluded that the tonsil is a factor in the causation of rheumatism, scarlet fever and chronic heart disease. The tonsillectomized child is assured greater protection against these infections than his companion whose tonsils have not been removed."

Seeing Sound: The Study of Speech and the Accurate Graphing of Speech Vibration.—Although the value of perfection in speech was appreciated by the Hindu two thousand years ago, it has only been within the past century that attempts have been made to record the phonetics of speech by the actual graphs of waves of motion, as created in the production of voice. In an exhaustive dissertation on the study of speech and the accurate graphing of speech vibration, GOLDSTEIN (*Laryngoscope*, 1927, **37**, 551) traces the advances made in the technical development of "seeing sound" from the early attempts to prove that the origin of the natural alphabet of spoken language was based on the formation of the letters of the Hebrew alphabet and the conformation of these letters in relation to the organs of articulation; through the phone autograph of Leon Scott and the manometric flame of Konig; followed by the monumental work of that distinguished American inventor of the telephone—Alexander Graham Bell—and the application of electricity by Scripture; later by the adaptation of the oscillo-

graph by Crandal and Sacia, up to the recent invention of the "Osiso" by Legg. Recognizing the practical application of the Osiso for speech-wave instruction for the deaf child, the author outlines the purpose of the research work as consisting of: (1) The development of a new phonetic system of all vowel and consonant elements; (2) the preparation of phonetic text-books for the education of the deaf child by this system; (3) the study of the pathology of speech as recorded by speech graphs in defective phonation; (4) the instruction of the deaf child to correct his own speech as made possible by the actual visualization of his defective speech graph simultaneously with the model speech graph of the teacher; (5) the more accurate analysis of qualitative and quantitative phonetics as presented by sensitive osisograms. The initial step has consisted in the production of a model graph of every vowel and consonant element of speech. Composite osisograms have been produced in the attempt to establish standards. As the appreciation of voice vibration by the sense of touch is a less delicate messenger to the brain than the recognition of the osisogram by sight, the first practical objection of the Osiso's use will be to familiarize the eye of the deaf child with the model osisograms that represent the elements of sound and speech. These forms should be impressed on the active child brain as readily as the symbols of the alphabet and it should be possible to teach the phonetics of speech to the deaf child as readily as to teach him writing or reading by the usual symbols of the alphabet. Finally, the visual reception of speech as a rapid motion picture should offer no greater handicaps to the deaf child than his normal ability to rapidly read the text of a printed page.

Bronchiectasis Associated with Disease of the Nasal Accessory Sinus: Etiology and Bronchoscopic Treatment of Bronchiectasis.—With the advent of bronchoscopy as a means of diagnosis and treatment of pulmonary conditions renewed interest has been shown in bronchiectasis, the treatment of which has long been so discouraging. From an etiologic standpoint, CLERF (*Arch. Otolaryngol.*, 1927, **6**, 28) has found it convenient to classify bronchiectatic cases into two groups—those associated with nasal accessory sinus disease and those commonly not associated with it. Into the latter group fall such conditions as sequelæ of pneumonia, pulmonary abscess and bronchial foreign body of long standing. After a concise discussion of the etiologic and therapeutic aspects of his subject, the author concludes that "abundant clinical observations supported by experimental studies indicate that chronic disease of the nasal accessory sinus is a factor in the production of bronchiectasis. The inhalation route of infection plays an important part in cases of chronic bronchitis; in children the peribronchitis associated with peritracheal glandular involvement undoubtedly plays an important rôle; that examination of a patient complaining of chronic cough, with or without expectoration, is never complete until a careful study of the nasal accessory sinuses has been carried out; a negative opinion on sinus disease should not be given until every necessary diagnostic means has been utilized; that the unfavorable effect of chronic sinusitis on the bronchial infection in cases of chronic bronchitis suggests a similar influence in cases of associated bronchiectasis; that every patient complaining of unexplainable chronic cough or in whom

a questionable diagnosis of bronchiectasis has been made, should receive the benefit of diagnostic bronchoscopic and pneumographic studies, if considered advisable; that irrespective of their etiologic relationship, treatment for a coexisting bronchiectasis and suppurative sinusitis is not complete until the proper treatment is given for diseased nasal accessory sinuses and the bronchial condition."

RADIOLOGY

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Roentgen Therapy of Gliomas of the Brain.—From their experience with a series of cases, BAILEY, SOSMAN and VAN DESSEL (*Am. J. Roentgenol. and Rad. Therap.*, 1928, **19**, 203) conclude that Roentgen therapy of intracranial gliomas should be undertaken only after an attempt has been made to extirpate the tumor when localized, or after a decompression has been done in case the tumor cannot be localized. Roentgen therapy will not cure any glioma, but exercises a restraining influence upon the growth of the most rapidly developing types, notably the medulloblastoma and the spongioblastoma multiforme, possibly also the astroblastoma and the protoplasmic astrocytoma. It is probably wise to give a series of treatments postoperatively even in cases of benign gliomas with the exception of the fibrillary astrocytoma and the ependymoma, for some of them, notably the protoplasmic astrocytoma, possibly also the oligodendroglioma and the astroblastoma, have a tendency to increase in malignancy after operative interferences. The variable effects of Roentgen therapy upon the clinical symptoms produced by brain tumors of the same histologic structure, are probably due to the fact that the symptoms are in part, often *in toto*, caused by blockage of the circulation of the cerebrospinal fluid, cystic degeneration and hemorrhage into the tumor, and not by rapidity of growth. Roentgen therapy in any case of intracranial tumor must be given with the utmost caution for it may result in headache, vomiting, delirium, coma and even in death of the patient.

Osteochondritis Dessicans.—Originally described by Koenig and later by Freiberg, osteochondritis dessicans is receiving increasing attention. As RICHARD (*Am. J. Roentgenol. and Rad. Therap.*, 1928, **19**, 278) states the lesion in the knee joint is most clearly visualized in the anteroposterior roentgenogram. It is seen as a sharply defined shallow depression in which lies a button of bone. It is invariably found on the inferior surface of the inner condyle immediately opposite the mesial tubercle of the tibial spine which is unusually long, and it is this unvarying position quite as much as other characteristics which is responsible

for its recognition as a separate entity. As to etiology, the weight of evidence is in favor of a traumatic causation. Freiberg has described a similar lesion in the elbow, on the lower articular surface of the external condyle. The author has also observed such a case, but verification by operation was not obtained. He relates the details of an instance in which the hip joint was affected; the depression was on the superior articular surface of the right femur, and a sequestrum lay within the depression. The sequestrum was removed by operation and the pathologic diagnosis was osteochondritis dessicans.

Early Diagnosis of Tuberculosis.—Despite those who would place the Roentgen ray first, MINOR (*Am. J. Roentgenol. and Rad. Therap.*, 1928, **19**, 287) considers auscultation to be the most accurate means of diagnosis, but the doctor must be able to interpret its findings correctly, not always an easy task. In what the author calls granular breathing, the breath sound, instead of being continuous and smooth as in normal breathing, has rises and falls of intensity and sounds almost as though it were about to break into moist râles. A patch of this breathing limited to a small area and persistent is a very valuable early diagnostic sign, and before long râles will appear in this area if the case progresses. Feeble breathing is suggestive but not so diagnostic, while prolonged harsh expiration is strongly suggestive. Typical râles of early tuberculous infiltration are distinctly dry, sharp, few in number, heard at the end of cough following expiration, limited to a small area and persistent; they are the most strongly diagnostic sign. The majority of doctors cannot command the skilled procedure and interpretation which make the Roentgen ray invaluable as a diagnostic measure. The physician should be able to diagnose most cases without its aid, though no man who specializes in tuberculosis could dispense with it, but it must be taken by an expert and interpreted by him, and to rely on it alone for diagnosis is an unpardonable error. If either the regular steps or the Roentgen ray must be dispensed with, let it be the latter, but it gives the expert a breadth of information that is wonderful and invaluable.

Finding Tuberculosis for the Good of the Public Health.—For the diagnosis of tuberculosis before there are significant symptoms or physical signs, OPIE (*Am. J. Roentgenol. and Rad. Therap.*, 1928, **19**, 284) points out that two methods are available, namely, the tuberculin test and roentgenologic examination. A child under one year of age with positive tuberculin reaction should be the object of special care, for it suffers with infection that will probably prove fatal. Recovery of some infected children, whose number increases from the sixth to the twelfth month of age, modifies prognosis but does not impair the diagnostic significance of the reaction. A positive tuberculin reaction in several members of a family, especially in those below the age of ten years, indicates that they have been exposed to open tuberculosis in the household, and, on the contrary, negative reactions in all children of a family show that there has been no exposure. Diagnosis of tuberculosis as of other diseases depends upon the accumulation of all available information, but without roentgenologic examination recognition of the grave tuberculosis that has not yet affected general health is usually not possible either in children or in adults. Advanced tuber-

culosis of the tracheobronchial lymph nodes may be recognized in children with no physical signs of the disease, and in some of these instances latent disease ultimately becomes manifest. Spots of abnormal density in the lungs of children are often, but by no means always, caused by tuberculous infiltration. Recognition of the disease is aided by discovery of associated tuberculous tracheobronchial lymph nodes and by the tuberculin reaction. It is often possible to recognize apical tuberculosis of adults unaccompanied by physical signs. Approximately one-half of the husbands or wives of those who suffer with open tuberculosis have recognizable apical tuberculosis. A considerable part of the adolescent children exposed to open tuberculosis acquire apical lesions, and after a lapse of years symptoms and physical signs may make their appearance. Member of households who have been exposed to open tuberculosis should receive repeated roentgenologic examination to determine the presence and severity of tuberculous infection.

Radium Therapy in Tuberculous Cervical Adenitis.—Radium, according to ROBINSON (*Am. J. Roentgenol. and Rad. Therap.*, 1928, **19**, 140) if properly used is a safe procedure and gives a high percentage of cures. Unless sinuses are present no scars are left. Radical operation is contraindicated because of the tendency to recurrence and the disfiguring scars. In the author's series of 25 cases treated by radium, 18, or 72 per cent, are clinically well, 2 are dead and 5 are improved but still have active nodes.

The High Cecum.—In the course of fetal development the cecum migrates, rotates and descends to the middle of the right iliac fossa. Arrest of development may occur with failure in the stage of descent so that the cecum occupies an abnormally high position. Among more than 1000 patients examined with the Roentgen ray KANTOR and SCHECHTER (*Am. J. Roentgenol. and Rad. Therap.*, 1928, **19**, 101) found a high cecum in slightly more than 5 per cent. It is most frequently encountered in the male sex and in the sthenic habitus. It is not so frequently associated with certain reflex or toxic symptoms (headache, vomiting) as is the low cecum. Ileal stasis and colonic irritability seem to be closely associated phenomena. The relatively increased incidence of ileal stasis in high and normal, as contrasted with low ceca, may, therefore, be due to the greater irritability of the shorter colons. Constipation may be regarded as a function of colonic length. It appears be least common in high ceca, most common in redundant colons. Appendectomy, in general, is performed most often in low, least often in high ceca. On the other hand, a pus condition of the appendix is found most commonly in high and least often in low ceca.

Most Common Roentgenologic Sign of Duodenal Ulcer.—FREUD (*Fortschr. a. d. Geb. d. Roentgenol.*, 1928, **37**, 14) thinks that fragmentation of the barium mixture in the bulb is the earliest and most frequent sign of duodenal ulcer. As a result of this fragmentation the shadow of the bulb is not homogeneous, but contains islands of increased density. There is also an impression that the bulb lacks tone and that the opaque media is in an inelastic, stiff or flabby walled tube. The author admits that apparently this sign is not as important as other direct signs, but he considers it sufficient for diagnosis.

NEUROLOGY AND PSYCHIATRY

UNDER THE CHARGE OF

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The Prognosis and the Late Results of Postencephalitic Respiratory Disorders.—TURNER and CRITCHLEY (*J. Neurol. and Psychopath.*, 1928, **8**, 191) classify the respiratory disorders in encephalitis as in their former paper as follows: (1) Disorders of respiratory rate, which include tachypnea and bradypnea; (2) disorders of respiratory rhythm, such as breath-holding spells, apneic pauses and Cheyne-Stokes respiration; (3) respiratory tics, comprising spasmodic cough, involuntary yawning, blowing, sniffing, etc. They review the rather meagre literature on respiratory disorders in encephalitis and call attention to the slight consideration given to the prognosis of the respiratory syndromes. They report some 29 cases of their own, 7 of which were recorded in their original paper. Of these, 2 cases were cured, 10 cases showed a cure of the respiratory disorder but other manifestations of the disease became worse or were unchanged, 2 showed improvement of the respiratory disorder but the other manifestations became worse or were unchanged, in 13 cases the respiratory disorder was unchanged, in 2 cases death occurred. Summarizing, the respiratory disorder disappeared in 12 out of 29 cases and improved in 2 others. In 15 cases it persisted unchanged up to the time of observations and in 2 instances until death. Fifteen of the cases showed tachypnea and in 9 of these the respiratory disorder was cured. One patient died. The other cases remained unchanged. There were 5 cases of breath holding of which 1 was cured, 1 had improved and 1 died. The other 2 had not improved. (The authors state "The other 2 had improved," apparently a typographical error.) Three cases of paroxysmal yawning were unchanged. Of 4 other cases of tics, 2 were stationary and 2 improved. One case of bradypnea recovered as far as the respiration was concerned. The association with Parkinsonism in 20 of the cases appeared to bear no parallelism with the severity of the syndrome or with its course. Of these, 1 patient died, in 8 the respiratory disorder was unaltered, in 2 it improved and in 9 it disappeared. The 9 cases in which no Parkinsonism coexisted included 1 fatal case, 3 cures and 5 unchanged. In a similar way the presence of psychotic manifestations showed no parallelism with the course of the respiratory disorder. As to age, 15 patients were in the second decade, 3 in the first, 6 in the third, 2 in the fourth, 2 in the fifth and 1 in the sixth. There were 21 males and 8 females. Twenty-three of the 29 cases had their original illness in the 1924 epidemic. They call attention to the variability of these respiratory disorders. Most of the instances are paroxysmal in

character. Frequently the attacks occur only toward nightfall but sometimes the attacks are much worse shortly after waking in the morning. In a few cases the disorder invariably follows the awakening from sleep, irrespective of the hour. Occasionally it occurs only during sleep. Emotional stress seems to be the most potent aggravating factor but pleasurable excitement may be accompanied by a respite from the attacks. Intercurrent illness or noxious stimuli generally tend toward an improvement of the respiratory attacks. Eating may have an influence. Extraneous stimuli may cut the attacks short temporarily. Medical and physical treatments have not been effective in any of these cases. Real improvement when it occurs seems to appear spontaneously.

Myasthenia Gravis.—Nielsen and Roth (*J. Nerv. and Ment. Dis.*, 1928, **67**, 32) present 3 cases. They call attention to the meager knowledge of this disease which, because of its rarity, is difficulty to study. The 3 points presented offered the following points for comparison: Case I presented poorly developed musculature with evidence of involvement of the bowels, history and sexual excesses and severe psychic trauma. Case II presented history of pregnancy just completed, basal metabolic rate of −36 with evidence of myxedema and of vegative imbalence with involvement of the bowel. Case III presented poor musculature and evidence markedly suggestive of syphilis of the central nervous system. All 3 cases had the typical onset and the typical development of myasthenia gravis and all 3 presented the myasthenic reaction of Jolly. The authors do not consider the myxedema, the syphilis or the psychic trauma as causative but rather as coincidental in these cases. They make the following observations: (1) Myasthenia gravis seems to occur in persons with small or flabby musculature in general. (A case was seen by the reviewer occurring in a Polish miner of exceptional physique.) (2) When myasthenia gravis develops the bowels are weakened just as is the general musculature. (3) The myasthenic reaction of Jolly is not necessarily present in all muscles at any time. It may be absent during remissions or may be present only in the weakest muscles. (4) Strychnin seems to have little influence on the course of the disease. (5) Basal metabolic rate is normal. (6) They assume the origin of the exhaustion to be probably neuromuscular.

Forced Conjugate Upward Movement of the Eyes Following Epidemic Encephalitis.—Taylor and McDonald (*Arch. Neurol. and Psychiat.*, 1928, **19**, 95) review very briefly the literature upon the subject and present 13 cases. They call attention especially to the frequency, the organic nature of the symptoms and its association with postencephalitic Parkinsonism. Their 13 cases come under observation in a period of about one and a half years. The cases as reported are undoubtedly postencephalitic in character. The movements of the eyes in all cases were predominantly upward. In 4 cases this was combined with lateral movement. In 1 case there was slight external rotation of the right eye and in 1 case downward alternated with upward movement. Associated movements of the head occurred in 5 cases. The frequency of the attacks varied widely from those that occurred

daily to those that occurred two or three times a week, but there was no constant interval between the attacks. The duration of the seizures varied from one or two minutes to nine or ten hours. Sometimes the attacks occurred at intervals of half an hour for a few hours. Other accompanying conditions of the eyes appeared of little significance in relation to the deviation. Treatment by scopolamin was effective in 8 cases and in 2 it was without result. In some cases the spasm would disappear when the patient lay down and at times this was the only way in which the spasm could be overcome. One patient was obliged to lie on the right side to stop his spasm. In 1 case the patient was at times unable, because of the spasm, to close the eyes at night and was thereby prevented from sleeping. The authors do not attempt exact localization of the lesion but assume that it lies in the region of the striatum or in the coördinating mechanism of the ocular nerves. They call attention to the lack of unanimity of opinion regarding the wide range of possibilities.

Physical Problems of Abnormal Behavior.—WILE (*Am. J. Dis. Child.*, 1928, **35**, 113) states that man's behavior is conditioned by the state of development of his nervous system, but no less so by the condition of his visceral, skeletal and reproductive systems. He calls attention to the great difficulty of determining abnormal behavior due to variations in customs, environments, states of civilization and so forth. He thinks this calls for interpretation of behavior socially in terms of time, place and circumstance and defines abnormal behavior "as a variation from accepted standards of behavior." Abnormal behavior would be that which runs counter to the views, beliefs, habits and customs of at least 60 or 75 per cent of the people." He considers deviations in the realms of the physical, the emotional reactions, the intellectual processes and social variations. He emphasizes the psychobiologic unity of behavior in man. He then presents hypothetical situations to illustrate potential effects of physical disabilities on behavior. "The total effect of a physical disability is rarely predictable. The nature of the physical factor does not indicate its effect on behavior any more than one may be certain concerning the metastases of some forms of tumor." But he warns against assuming that a particular form of abnormal behavior is due to the obvious physical condition. It may be present on a psychogenic basis. He classifies physical disabilities as those which effect (1) purely physical expression of activity, (2) the mental element in behavior, (3) the emotions and (4) social activity. He then states "There is a marked tendency to explain all types of behavior as due to endocrine function or dysfunction. The whole subject of endocrinology is still in a state of clinical chaos. Comparatively few of the behavior difficulties of children are proved to be primarily due to disorder of the ductless glands." In his concluding paragraph he makes it clear that he is simply attempting to indicate that the physical problems of abnormal behavior are not isolated in human welfare. "Behavior is the sum total of reactions. Hence, the physical variations and deviations of man as a reacting, adapting mechanism require interpretation in the light of his intellectual, emotional and social growth."

PATHOLOGY AND BACTERIOLOGY

UNDER THE CHARGE OF
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Rheumatoid Arthritis: Is it a Deficiency Disease?—In a study of chronic arthritis extending over many years ROWLANDS (*Proc. Roy. Soc. Med.*, 1927, **20**, 1711) had had in his rheumatoid arthritis patients bacilluria and intestinal stasis as very constant findings. He attempted to discover the cause of these conditions by means of a study of vitamin deficiency diets. He used pigs and rats and found that the anatomic character of the intestine was markedly altered with a diet deficient in vitamin B; there was associated stasis and he believed the condition was a result of toxemia with a disease of the trophic nerves. His report is not clear as to what he included in the term "rheumatoid arthritis," but his experiments were not carried on long enough to include the joint changes, if such occur, in his animals; however, the correlation of his results with the clinical findings in human cases suggested that a partial deficiency in vitamin B might be an essential factor in many of these chronic arthritides of unknown etiology. He believed that the intestine, greatly altered as it is in the vitamin-deficient animals, allows the more ready influx of Bacillus coli; there was also absorption of toxic substances and this he considered brought about a type of paralysis and resulted in atrophy as is seen in certain muscles about the involved joints. Injury he looked on as a predisposing cause determining which joint would be involved. The disease is one of civilization and increasing in frequency; he believed it due to the changes in our diet during the last hundred years—the bread used and the feeding of cows and hens on diet deficient in vitamin B resulting in milk and eggs also deficient. The treatment recommended emphasized an excess vitamin B diet particularly with a preparation of detoxicated wheat embryo; removal or treatment of sources of infection and immunization of patients against infection. The discussion covering ten pages of the report is rich in information and abbreviated opinions of many of the British workers in this field.

Tuberculosis in Infants: The Incidence, Significance and Course of Infection in Racial and Other Groups, and its Relation to Exposure.—ASSERSON (*Am. Rev. Tuberc.*, 1927, **16**, 359) reports the results of an investigation conducted by the Children's Committee of the New York Tuberculosis and Health Association of tuberculosis among children under two years of age. This consisted in a study of 4003 infants of this age group who had been treated and routinely skin-tested at New York Nursery and Child's Hospital and Babies Hospital and clinics from 1920 to 1926 in addition to which 1656 children of the same age who were in attendance at Baby Health stations and clinics were included in the investigation. Among the 4003 children in the two

hospitals the incidence of tuberculous infection was 11.4 per cent, many of whom had advanced tuberculosis; whereas of the 1656 children at health stations, the majority of whom were in good health, the incidence of infection was only 3 per cent. Therefore, to obtain a proper conception of the real incidence of infection among the general infant population, a cross-section of the infant community including all nationalities and social strata must be studied. Although the racial incidence of infection varied from 15.6 to 11.4 per cent in colored, Irish, Italian, American and Jewish races, the tuberculous death rate of infants followed that of the general population and varied from 1.2 per cent among Jews to 7.8 per cent among the Irish. A follow-up study of the 460 infected cases revealed the fact that the infants' resistance to tuberculous infection is better than was formerly believed but that, on the other hand, the infants' resistance to tuberculous disease is relatively low. This is illustrated by the fact that of those with manifest disease 82 per cent are dead from tuberculous disease, whereas among those with infection but no manifest disease 3 per cent are dead of tuberculosis, 32 per cent of intercurrent infections and 65 per cent are living. Further work shows that infants subjected to continuous exposure in the home have a very slight chance of escaping disease and death from tuberculosis. Those receiving their infection in a more casual and less continuous manner show marked resistance to tuberculous infection. This report leaves no doubt that the removal of the infant from the source of infection is quite justifiable, but the author points out that the care they receive in institutions to which they are sent must be excellent or the parents will not consent to hospitalization.

Special Aspects of the Declining Tuberculosis Death Rate in the United States.—DUBLIN and VAN BUREN (*Tubercle*, October, 1927) report an analysis of the tuberculosis death rates taken from the statistics of the twenty states in the United States Registration area in 1910, together with the records of the Metropolitan Life Insurance Company. They came to the conclusion that the decline in death rate is general throughout the country, but that it is more marked in urban centers than in rural areas. The greater decrease is still present in cities, when permanent residents only, are considered. The reduction in death rate is evident in the negro as well as the white population, although it is not so marked there as in the latter people. By comparison of the deaths from tuberculosis with deaths from all causes it is evident that in 1911 to 1913 one-fifth of total deaths in wage earners was due to tuberculosis whereas in 1922 to 1924 this ratio had been reduced to one-seventh of the total deaths. The decreasing mortality is evident in all occupations, save that of metal miners, where it has increased. It is suggested that this may be an apparent rather than real increase due to the decreased numbers of fatal accidents, and so forth. The decrease in death rate from tuberculosis has been greatest in that stratum of population where it is most helpful, that is, the wage earners. This decrease applies to both male and female. These results are high gratifying from a public health standpoint and lend weight to the hope that tuberculosis may eventually disappear or become a relatively rare disease—at any rate we may look forward to a sharp decline in the tuberculosis death rate in the near future.

HYGIENE AND PUBLIC HEALTH

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Further Laboratory Investigations of Typhoid in Alabama.—HAVENS and DEHLER (*J. Prev. Med.*, 1927, **1**, 359) found brilliant green bile to be a satisfactory medium for the transportation and cultivation of specimens for typhoid examination. The preparation of this medium is described. Its effectiveness is indicated by 80 per cent positive results from a single specimen of feces taken at random during the disease in 108 cases of typhoid fever. The results of carrier surveys are described. Among 1076 dairy workers 39 typhoid carriers, 13 carriers of paratyphoid A and 3 of paratyphoid B were found. The examination of 348 persons who gave a history of an attack of typhoid fever yielded 33 typhoid carriers (9.5 per cent). Seven paratyphoid A and 5 paratyphoid B carriers were also found. The importance of repeated examinations is emphasized. The carrier condition in this group bore no relation to sex, the percentage among males being 9.3 and among women 9.6. Those individuals who had typhoid in childhood yielded approximately the same number of carriers as those attacked in adult life. A small number of agglutination tests showed no relation between the carrier state and the presence of agglutinins. The results of this survey suggest doubt that gradual spontaneous clearing up of the carrier condition ceases altogether even years after the disease, although it is improbable that this is of practical significance. The examination of 35 persons in close contact with active cases of typhoid fever disclosed 7 carriers, none of whom had had the disease. Subsequent examinations were negative, and this fact, together with previous observations in the literature, indicates that contact carriers are not uncommon among groups exposed to repeated massive infection. Due consideration should be given to this possibility in epidemiologic investigations of the origin of the infection. These carrier studies further suggest that a correlation may be established between the number of healthy carriers and the incidence of the disease in a given population.

Experimental Immunization in Poliomyelitis.—AYCOCK and KAGAN (*J. Immunol.*, 1927, **14**, 85) find that infection results from subcutaneous injection of attenuated virus in about 25 per cent of animals. About 25 per cent of animals vaccinated with attenuated virus resisted subsequent intracerebral inoculation. Infection results from subcu-

taneous injection of active virus in about 25 per cent of animals. Thus, it appears that virus subjected to "attenuation" (phenolization, glycerolization or drying) possesses little, if any, less infectivity than active virus when injected subcutaneously. A large number of intracutaneous injections of active virus does not produce infection. Intracutaneous injection of active virus repeated for a considerable time protects monkeys from intracerebral inoculation or prolongs the incubation period. Of 12 monkeys receiving repeated intracutaneous injections of active virus, only 1 developed paralysis. Of the surviving animals, 2 resisted three intracerebral inoculations, 2 resisted two intracerebral inoculations, and 2 resisted one intracerebral inoculation but succumbed to a second inoculation, 1 of these with a prolonged incubation period, and 3 animals resisted a single intracerebral inoculation, but were not retested. One animal did not resist intracerebral inoculation but the incubation period was prolonged. Four of the resistant animals also received from one to five subcutaneous inoculations of active virus from which no symptoms resulted. Blood serum of monkeys vaccinated by the intracutaneous method neutralizes the virus of poliomyelitis *in vitro*. Blood sera from 8 of the vaccinated animals neutralized virus *in vitro* twenty-one times, while in two other instances the virus was partially neutralized as evidenced by prolongation of the incubation period. Blood sera which only partially neutralized had on previous occasions completely neutralized the virus, in 1 case four times. The blood serum of 1 animal which did not resist intracerebral inoculation completely neutralized the virus. In respect to the epidemiology of poliomyelitis, these observations lend support to the idea that immunity may be accomplished without active symptoms, and that the neutralization of virus by serum of "normal" individuals is an indication of acquired immunity to the virus and is not a property of normal serum.

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